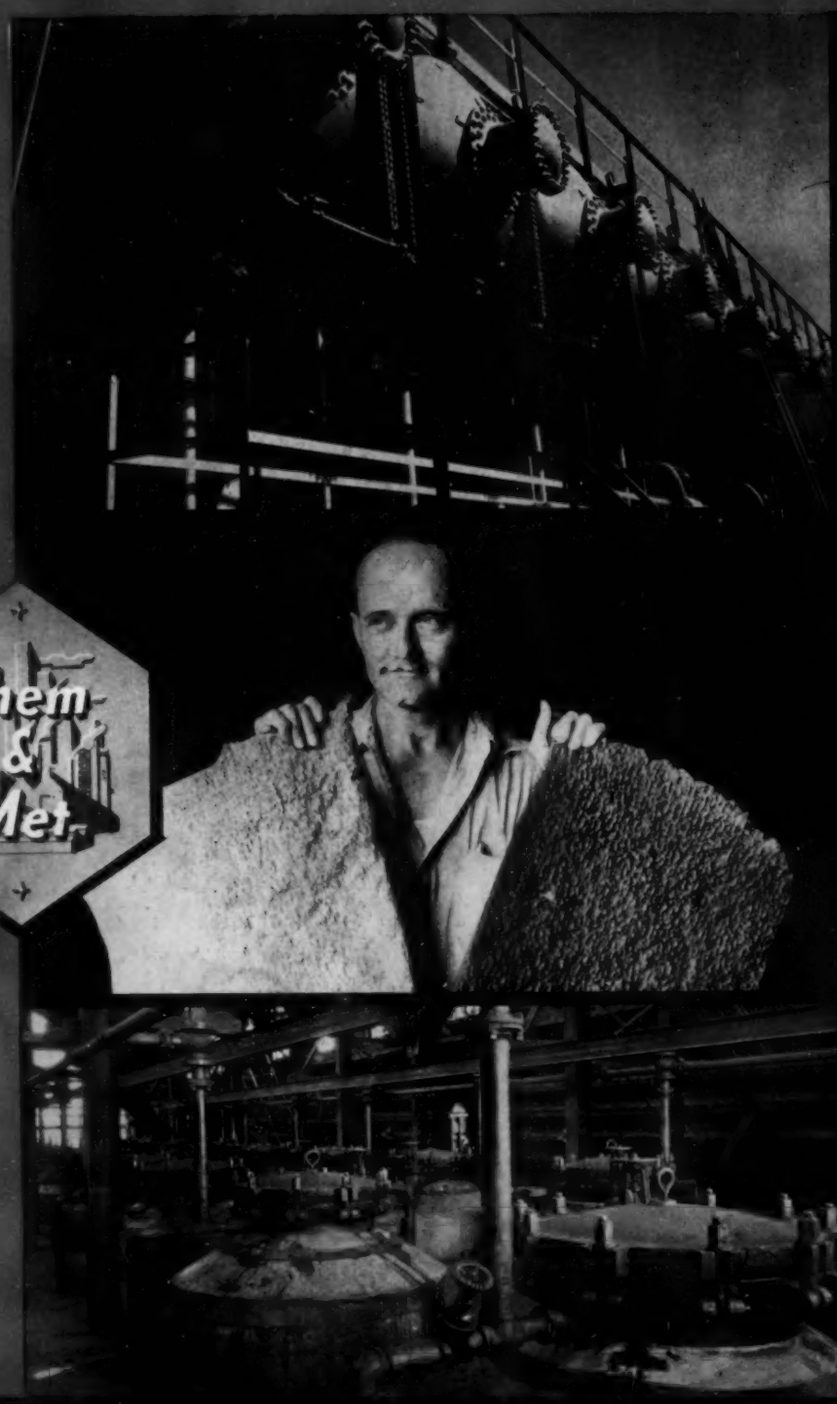
CHEMICAL & METALLURGICAL ENGINEERING



MARCH, 1942

PETROLEUM'S HYDROCARBONS GO TO BATTLE

Both the bomber's fuel and fuel tank should and probably will be synthesized from raw materials out of the same oil well. See pp. 83 to 87 for the relations between 100-octane aviation gasolines and synthetic rubber's chief raw material — butadiene

RUBBER'S "V FOR VICTORY" IS ON ITS WAY

Today's greatest challenge to the rubber, petroleum and chemical industries is seen in the tremendous demands for synthetic production. Twenty or more plants will be required to yield our minimum requirements. Properties of the principal available types are discussed on pp. 78 to 82

STEWING UP STUMPS FOR CHEMICAL PRODUCTION

The lowly pine stumps of Georgia, Florida, Mississippi and other Southern states are rapidly developing into our principal source for an increasing number of new terpene chemicals in addition to naval stores and wallboard. For a pictorial flowsheet of these processes, see pp. 112 to 115

WASHINGTON NEWS pp. 120-121

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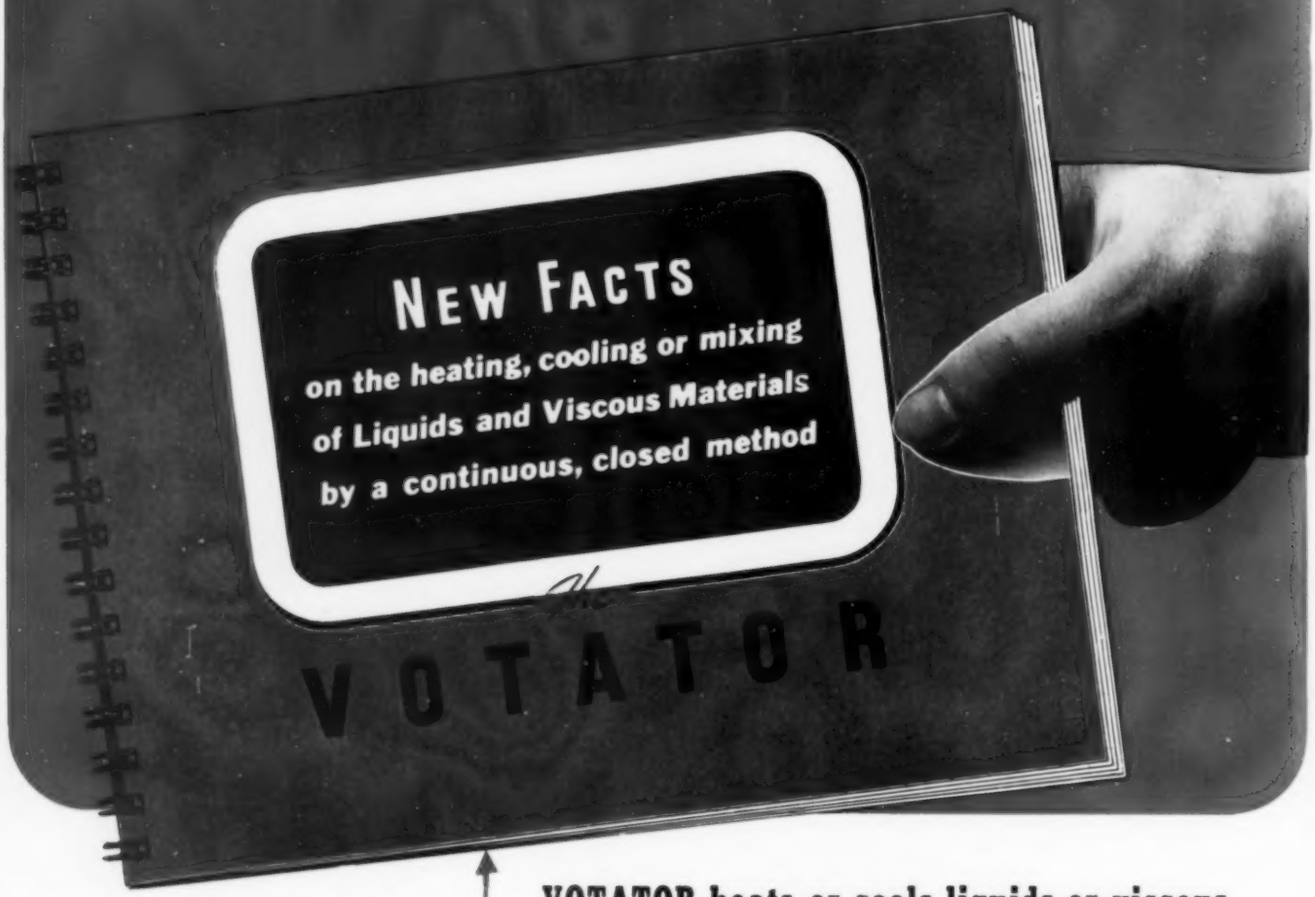

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WHAT'S AHEAD

Electronic devices, including thermionic tubes and photocells, are becoming tremendously important in process control. This month's *Chem. & Met.* Report deals with types and principles of these devices. The Report next month will discuss applications of the tubes and cells, as well as certain types important for process uses other than control.

In May, *Chem. & Met.*'s annual chemical engineering study will be on "Diffusional Processes." In this 48-page report it is planned to include discussions of theory, descriptions of equipment and outlines of current practice. The unit operations to be covered are: Drying, Distillation and Rectification, Gas Absorption and Extraction, Crystallization and Dissolving.

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ESTABLISHED 1902

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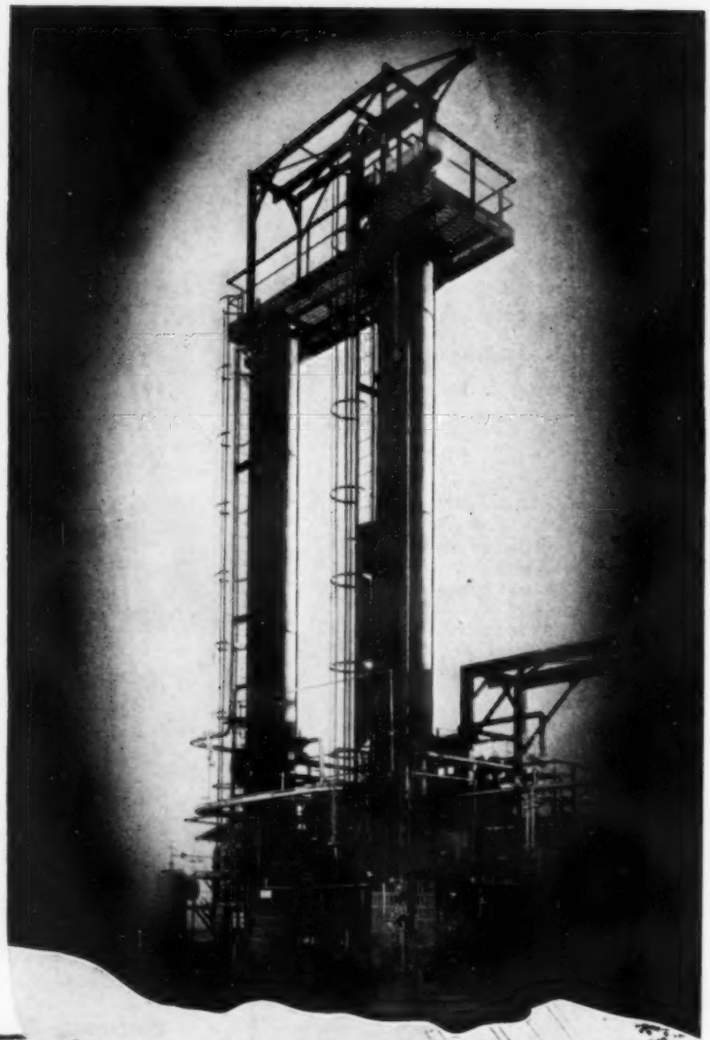

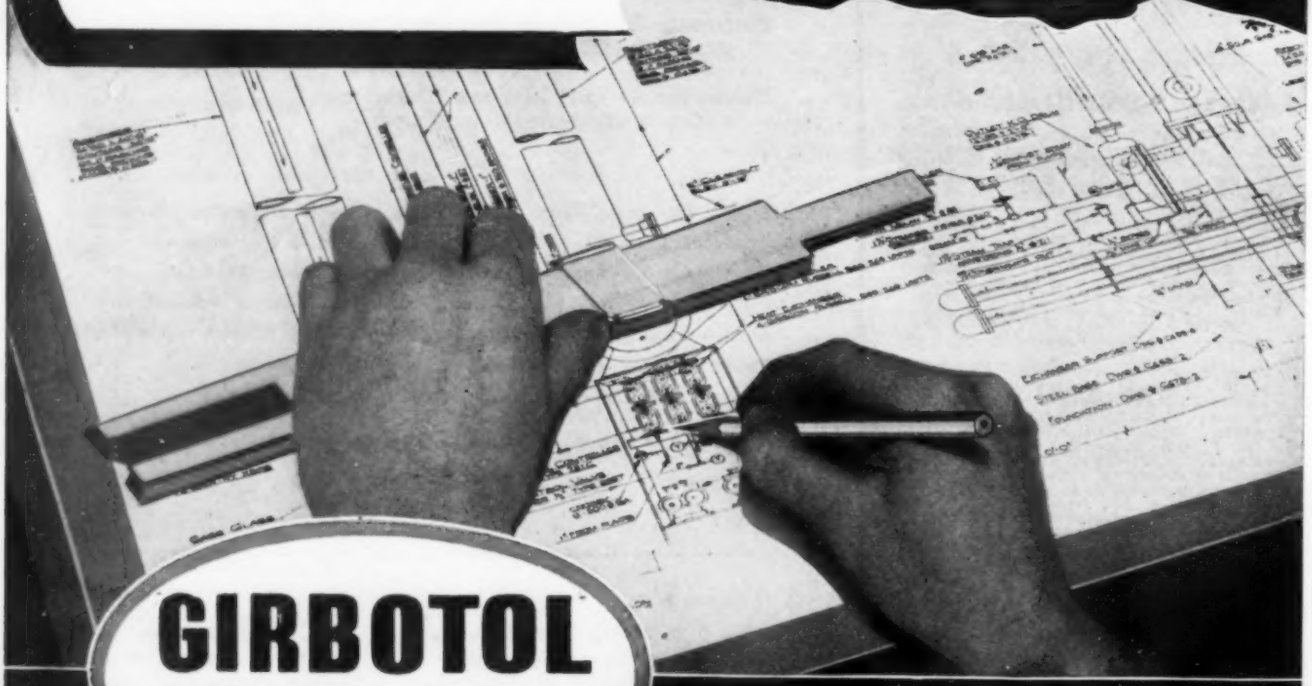

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CHEMICAL & METALLURGICAL ENGINEERING

ESTABLISHED 1902 S. D. KIRKPATRICK, *Editor*

MARCH, 1942

UNCOVER THE UNORTHODOX

COLONEL MAURICE E. BARKER of the Chemical Warfare Service made headlines all over the United States the other day when he said that what this country needs most now is a non-comic-strip ray gun. The wide reaction to his chance remark, before a student group at the College of William and Mary, may reflect only the shallow and wishful thinking of those who would like to see this war won by some of Buck Rogers' 25th century technology. Yet there may be food for more sober thought in the idea that the scientists and engineers of this country have got to do more to help the war program. We are pitted against ruthless enemies that are staking their every resource in a desperate effort to conquer the world. So far they have been getting away with it. And they will continue until we have mustered the scientific brains as well as the manpower and materiel to beat them at their own fiendish game.

Lately some of us had the rare privilege of hearing Canada's commanding officer, Lieutenant General A. G. L. McNaughton, address his fellow engineers on the occasion of his recent return from the other side. He said bluntly and forcefully that this war was not going to be won by orthodox methods or by mere manpower sent as expeditionary forces to do guard duty in various outposts of the British Empire. His plea was for the scientists and engineers of Canada to develop new and more deadly weapons. He was looking for help, not from the politicians or from the brass hats of the army of yesterday, but from his former colleagues and associates in the National Research Council and in the laboratories of Canadian universities and industries. Judging from the fervor with which the General's plea was received, our guess is that great things will be forthcoming—developments as important now as once were the Banting discoveries of insulin in more peaceful time.

No one can deny that we have made progress here in mobilizing our research and developmental resources for war work. The various agencies and committees included under the broad program of the National Academy of Science have drafted some of our best scientists and most resourceful engineers. Yet many of us have the impression that there is still a discouraging gap between the laboratories and drafting boards of some of our war industries, between research and production of new and better processes, as well as weapons. We still rely too much on the strategy of the past.

Our present need is for output of absolutely necessary equipment—of planes and ships, guns and ammunition. Orthodox methods, standardized designs and other mass production techniques will get quickest results and, of course, there is no time to lose. Nevertheless, we must not be afraid of change and must seek constant improvement—even radical and revolutionary developments in every line of manufacture. Otherwise we are going to be handicapped in fighting better equipped as well as better prepared enemies.

With this in mind we want to urge our government to give more serious and sympathetic consideration to the vital role of research in the war effort. Our Selective Service Director must help to make it clear to the local boards that the man in the laboratory who is working on a new aviation fuel, a more powerful explosive, or a new alloy or plastic is just as important as the man in the plant. And that both, in their present jobs, might conceivably be more important than a whole regiment handicapped with obsolete equipment.

Given opportunity and support, American engi-

neers and research men can help win this war in ways that no one can now foresee or predict. They have what it takes in scientific knowledge and resources. They are already on the job, but they need a little encouragement—especially from those in high quarters who can and will put to test their ideas—however unorthodox.

THEIR BROTHERS' KEEPERS

ALPHA CHI SIGMA, the professional chemical fraternity with 15,000 members, 46 collegiate chapters, and 25 alumni groups in our principal chemical centers, has again contributed a signal service to the advancement of chemistry and chemical engineering. By setting up a comprehensive safety program in cooperation with the National Safety Council, it is going to help get the principles and objectives of the safety movement established in the classrooms and the laboratories of American colleges and universities. Thus will be brought home to the student early in his academic career the vital relation between theory and practice when it comes to accident prevention and the saving of life and property.

Credit for organizing this program goes to H. B. Stevenson of Procter & Gamble, who, as a district counselor of the fraternity, helped to formulate systematic instruction in safety at the University of Cincinnati and at Case School of Applied Science. Now, under the chairmanship of F. R. Holden of Mellon Institute, an active committee is spreading out the program to reach all collegiate chapters. Meanwhile the national organization of Alpha Chi Sigma is helping to finance memberships in the National Safety Council and is otherwise backing up the work of its committee.

In the past our educational institutions have often been severely indicted because graduate chemists and chemical engineers have been permitted to enter industry without intimate knowledge and understanding of the hazards that are involved in the use of high temperatures and pressures and in the handling of toxic and flammable materials. Such indictments have been all too frequent. Let us hope that the new generations of graduates will become so conscious of safety during their college days that they can inculcate among their associates a better understanding of the human principles on which modern industry must operate.

ANY IDLE EQUIPMENT?

TO AID in diverting idle and non-essential chemical engineering equipment to direct war purposes, there has been set up in the Chemical Branch of W.P.B. a new section on Chemical Plant Facilities. Its chief is C. T. Thompson whose office is in Room 2434, Temporary Building R, in Washington, D. C. He will serve as a liaison officer between people who may be able to produce some essential product and people who may have equipment not engaged in direct war production or have idle facilities. It should be noted, however, that this section is concerned only with equipment already installed and not with new equipment. Also those having such equipment should not only list and describe it and its past usage, but should, if possible, suggest applications for which it might be adapted. Finally, there is the question of whether the equipment can be used in its present place or would be available for relocation. Here, then, are job specifications for an opportunity to serve your country. Mr. Thompson invites your contacts.

IS YOUR SHOP FULL?

EVERY plant in the chemical process industries has a good machine shop for its repair and maintenance work. In some cases these shops may be working on an 8-hour basis only 5 days a week. The other 75 percent of the week should not find them standing idle in emergency times such as these when every minute counts.

Have you made any plans to keep all of the machines in your shop busy on a 168-hour week, turning out a needed item of war material when not actually needed for repair? There is no reason why a subcontracting arrangement cannot be made with a nearby producer of a war item. If the shop is really large, a prime contract may be justified.

Provision must, of course, be made for actual repair and maintenance needed in the plant. But intensive up-grading of present machine shop employees will quickly develop an adequate, skilled staff which can keep the machines running continuously making that extra effort which war necessitates.

Subcontracting exhibits of the contract distribution branch, War Production Board, are now open at the addresses listed below. Visit the nearest office and see what you can do to help.

City	Location
Atlanta, Ga.	Hurt Building
Boston, Mass.	Court Street Branch, First National Bank
Buffalo, N. Y.	White Building
Chicago, Ill.	Civic Opera Building
Cincinnati, Ohio	Union Central Life Building
Cleveland, Ohio	Union Commerce Building
Detroit, Mich.	Boulevard Building
Harrisburg, Pa.	Doehne Building
Helena, Mont.	222 Power Block
Kansas City, Mo.	Mutual State Building
Los Angeles, Calif.	Western Pacific Building
Memphis, Tenn.	Sterick Building
Newark, N. J.	Indemnity Building
New Orleans, La.	Canal Building
New York, N. Y.	Chanin Building
Philadelphia, Pa.	Broad St. Station Building
San Francisco, Calif.	Whitcomb Hotel
St. Louis, Mo.	Boatmen's Bank Building

WASHINGTON HIGHLIGHTS

CONVERSION of industrial plants must be prompt and thorough. This means that metal-working establishments in particular must do something of direct value on the war job, or else. . . . Otherwise, they will certainly be without raw materials because the shortage of metals is truly appalling. For chemical plants it means that the things made must be urgently wanted for war usage or for an absolutely essential civilian activity. Mere comforts or luxuries will no longer qualify.

ERNEST W. REID has been named chief of the Chemical and Allied Products Branch of W.P.B. Thus an outstanding public service rendered by an exceptionally able technical man is signally recognized. E. R. Weidlein, who cannot give full time to Washington activities, continues as an enthusiastic and invaluable consultant, giving particular attention to synthetic rubber. Promotion of Dr. Reid seems to have received unanimous support both within and without the government. In view of the quiet, though very competent job he has done, this is not surprising.

PUBLIC OPINION still has influence. During February it forced reorganization of the Office of Civilian Defense and turned that agency back to its original technical job. That was a good thing. It also compelled Congress to retreat from the proposed retirement annuities for members of Congress, the Cabinet and the President. That may or may not have been so good. It is easy to understand why the general public objected to pensions for politicians. But the public probably does not realize that the naming of lame-duck congressmen to government jobs, lest they be in straitened circumstances, already costs us more than the whole proposed pension system.

TANKER sinkings in dangerous numbers make certain a shortage of petroleum products in many sections of the United States. Mr. Ickes' worst forecasts of last Fall will be exceeded, but not for the reasons then given. This means that some process industries must substitute coal for oil wherever possible. Hence the storage of coal this Spring and Summer is being urged. This is one thing which should be hoarded by industry. Some firms which require oil may have to establish new processing units near the source of petroleum. Highly desirable projects for the Northeastern States may not be practical there. Making of butadiene, for example, would have to move largely to Texas and the Southwest.

ALCOHOL making is still the subject of bitter controversy in Washington. The huge new requirements for synthetic rubber and smokeless powder caused most of the trouble. But much more commotion resulted from inaccurate, biased and even erroneous statements that seemed deliberately distorted. There is no question but that the government will give alcohol makers the very minimum quantity of sugar or edible alcohol which is needed for the minimum safe total alcohol production of the country. Preference will be given to every other raw material first. But the narrow margin of corn supply above demand is making it necessary even to substitute wheat as a raw material in some cases. Meanwhile, the "power alcohol" and "chemurgic" politicians from the Middlewest are having a field day with their rumors of a sinister control of alcohol and rubber by international chemical and petroleum interests.

EXPANSION of industrial production is urgently wanted with respect to almost every chemical. But this expansion must be accomplished with present manufacturing facilities if that is humanly possible. Even lower efficiency and makeshift chemical engineering methods are preferred to the spending of time or scarce equipment on plant additions.

DELAYS in synthetic rubber production have already occasioned severe Congressional criticism, and formal inquiry. A lot of folks would like to find out whether the R.F.C. Czar deserves his cocktail party nickname of "Bottleneck" Jones.

BETTER LOAD FACTORS for electrochemical industry are being urged by the engineers of the Federal Power Commission. They ask that peak demands be curtailed, especially at peak-load hours on local utility systems. The curtailment of output of a continuous process industry, if it slows down only two hours each afternoon five days a week, is not serious. Such slowdown often makes available to the operating company power which otherwise would not be allocated to it. Then, if priorities for equipment can be had, one finds the anomaly of lower power bills, greater production and lower peak loads on the power line. All of these desirable objectives should be investigated by every electrochemical management.

ALUMINUM and possibly magnesium, production from 6-mill power is almost certain to come. Location of such plants in the suburbs of the large metropolitan centers will help to take up the slack in the few areas where a surplus of firm power is still available. All admit that these are "white elephant" plants, erected only to meet the present emergency.

EXPLOSIVES making may be slightly curtailed in order to divert some nitrogen products to the fertilizer business. This queer war-time situation develops from a combination of huge new food demand for our Lease-Lend friends at the same time that import of Chilean nitrate becomes extremely difficult because of ship shortage. We do not dare to tell the British, Russians, or Chinese that we will not help to feed them. But to feed them, we must have more Chilean nitrate or ammonium sulphate for top and side dressing of both sugar and oil-seed crops. The need for more fertilizer nitrogen next year will be much more than an academic factor in military planning.

DONALD NELSON says that this (1942) is the crucial year, not 1943. "We had our golden opportunity to expand capacities in steel, chemicals and other materials and neglected it. That opportunity is gone forever, so far as this war is concerned. This year we have ten silver months ahead. What we produce for ourselves and our Allies now is worth ten times what we produce next January!" Management holds the key. Think what it would mean if every chemical company in the country could improve the efficiency of its management to reach that of the best run enterprises. It is safe to say that output of war production would go up 25 percent without any added equipment or new facilities.

Synthetic Rubber in Industry

H. H. HARKINS, *United States Rubber Co., Providence, R. I.*

Chem. & Met. INTERPRETATION

The rising synthetic rubber production and the rapidly diminishing supply of the natural material give rise to the consideration of how the new types of rubbers can be used for construction of equipment in the process industries. Dr. Harkins discusses the peculiar characteristics of each of the synthetic rubbers that are now being produced commercially with special emphasis on their resistance to heat, oxidation, oil, and chemicals.—*Editors.*

DURING the past two or three years there has been much public discussion of synthetic rubber. Many applications have been found, but the volume of synthetic rubber used thus far compared with the volume of natural rubber consumed is slight. The total production of all synthetic rubber in 1941 was only about 1½ percent of the crude natural rubber consumption. While this may not seem an impressive figure for synthetic rubber, the production has laid the basis for possible further expansion which is of great significance in time of emergency. Much further expansion of the synthetic rubber industry is contemplated. Mr. Jesse Jones recently announced that the Reconstruction Finance Corporation will appropriate $400,000,000 for the construction of additional synthetic rubber plants to bring the annual production of synthetic rubber up to 400,000 tons per year.

One of the principal reasons why the use of synthetic rubber has lagged so far behind natural rubber is due to its being produced in the Far East with cheap labor at a price so low that synthetic rubber cannot compete. Hence, the only uses for synthetic rubber thus far have been for purposes for which it is superior in performance to the natural product. With the sources of natural rubber imperiled, or cut off entirely, synthetic rubber becomes a subject of vital interest to all of us.

Rubber manufacturers are keenly aware of their responsibilities to industries using this material. Under instructions from the government and also on their own initiative rubber manufacturers are endeavoring to (1) conserve natural rubber wherever possible, (2) see that rubber is allocated to the essential needs of industry, (3) use substitute materials where warranted; for example, reclaimed rubber, (4) study intensively the processing and the properties of synthetic rubbers with the idea of using them wherever possible when they are available in sufficient quantity.

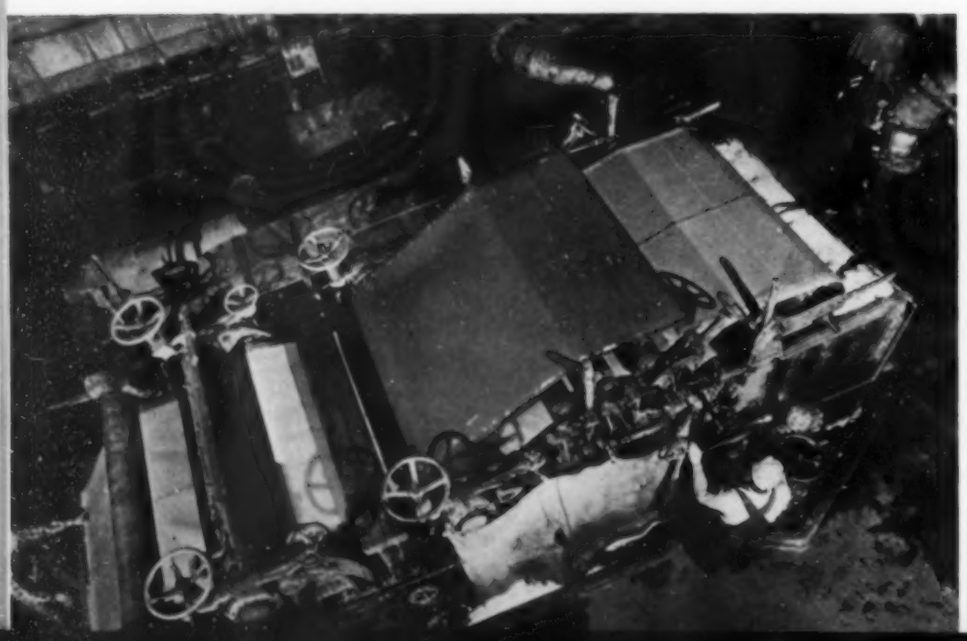
On the assumption then that in the immediate future we will have little natural rubber, but a moderately good supply of synthetic rubber, to what extent can our basic needs be satisfied? This question is too big for any one to answer definitely at the present time. However, we may consider the fundamental properties of the synthetic rubbers and thereby gain some insight into the possibilities of using them for various applications in industry.

Before discussing "synthetic rubber," it is advisable to define this term. Many attempts have been made to build up high molecular weight hydrocarbons to yield a product like natural rubber. None of these efforts has been successful. Therefore, synthetic rubber does not mean a product identical with natural rubber. It has been possible to build up or polymerize various substances or mixture of substances which can be made to yield materials of high strength and elasticity resembling natural rubber in physical properties. There are many synthetic products which exhibit these properties in some degree. It is in this rather loose sense then that the term synthetic rubber will be used.

The more important synthetic rubbers, their chemical and mechanical properties, will be discussed and some of their possible uses will be mentioned.

For detailed information on any particular synthetic rubber the manufacturer should be consulted. The statements which will be made are based to a large extent on information received from the manufacturers

Buna S can be bonded to metal satisfactorily and hence may prove useful as a lining material to replace rubber in the paper and other process industries



Based on a paper presented before the recent annual meeting in New York, N. Y., of the Technical Association of the Pulp & Paper Industry.

coupled with the author's own observations. They do not necessarily represent the views of the company with which he is connected or of the manufacturer of the synthetic rubber. In comparing these synthetic rubbers, every effort has been made to be fair. This comparison is made difficult by the fact that the properties of any one are largely dependent upon the processing, compounding, and curing it has received.

It must be made clear at the outset that no one synthetic rubber is satisfactory for all purposes for which a rubber-like material is required. But by taking advantage of all of the various synthetics it may be possible, by making use of the best property of each, to satisfy most needs.

According to one authority 29 varieties of synthetic rubbers were studied in 1941, and that one manufacturer has made over 200 synthetic rubbers. It would be impossible to discuss all of these, even if complete information were available, which it is not,—therefore consideration will be confined to the few types that are now commercially available. It is necessary to point out that in the discussion to follow there are numerous products under each heading, and therefore no generalizations are valid. The rubber technologists have been busy formulating compounds which would accomplish certain things which were not supposed to be possible for rubber. Exactly the same possibilities exist for compounding each of the synthetic rubbers. Consequently, any iron-clad rule concerning synthetics today may prove to be erroneous tomorrow in view of the development activity which is sure to take place in the field because of present conditions.

The first commercially successful, and best known synthetic rubber is neoprene which is made by the duPont company (polymers of chloroprene—several important commercial varieties are being produced). Neoprene can be processed on rubber machinery with nearly as much ease as natural rubber. When properly compounded and heated, it polymerizes or "vulcanizes" to a product resembling natural soft rubber. It is better than rubber with respect to:

(a) Oils

(b) Deterioration by heat, oxygen, and sunlight

(c) Flexing life

(d) Gas diffusion

Usually it is less resistant to water than is rubber, but it can be formulated to yield products that are better than rubber is in resistance to hot water. These properties of neoprene make it useful (sometimes preferable to rubber) for certain products such as,—

(a) Hose, gaskets, packings

(b) Transmission and conveyor belts

(c) Boots where oil is a factor

(d) Soles and heels where an oil condition exists

(e) Tank linings where oil or high temperatures are encountered, or both

(f) Soft roll cover, especially printers' rolls

Quite recently neoprene has been made available in semi-liquid condition so that it may be used as a high solids paint or as a troweling compound. This type of plasticized neoprene may be of value for various corrosive conditions in the pulp and paper and other process industries.

One very important characteristic of neoprene is that a good product can be made which is light in color or even white. This is not true of some of the other synthetic rubbers.

Butadiene, a hydrocarbon obtainable from petroleum or other sources, will polymerize to yield a rubber-like material. However, much better rubbers are obtained by interpolymerizing butadiene with other compounds containing an active vinyl group, such as styrene, acrylonitrile, vinylidene chloride, or other vinyl compounds (E. R. Bridgwater, *Chem. & Met.* p. 139, Oct. 1941).

Perbunan or Buna N is a copolymer of butadiene and acrylonitrile. Next to neoprene it is the best known synthetic rubber. Perbunan will vulcanize with sulphur just as natural rubber will, and can be made to yield compounds of all degrees of hardness ranging from soft inking-roll stocks of 5-10 durometer up to a very hard ebonite. This synthetic rubber is characterized by the fact that carbon black must be incorporated if high tensile strength is demanded. Any so-called Perbunan stock which is light colored is likely to have low tensile strength and the other properties will be poor also.

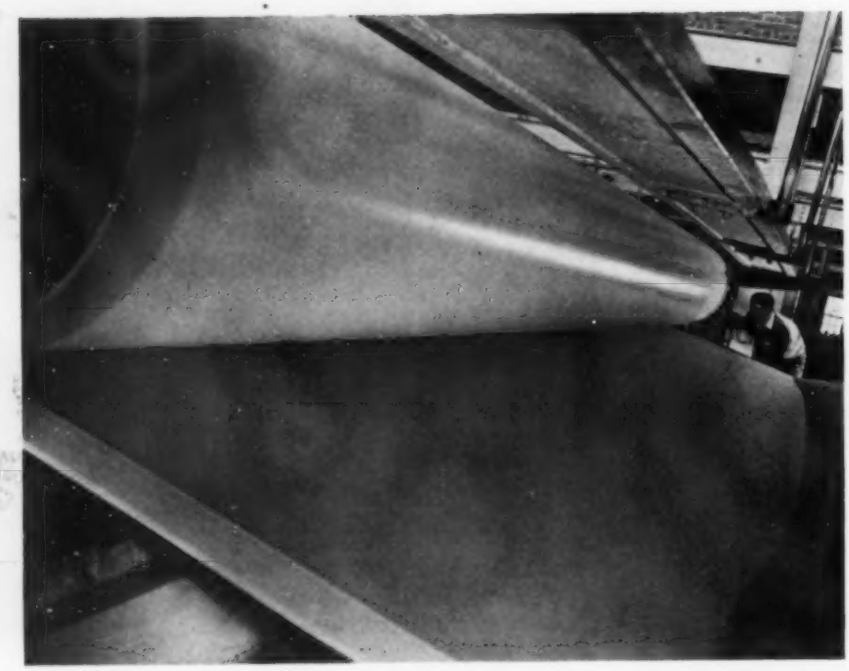
Perbunan vulcanizates are very resistant to aliphatic oils, quite resistant to heat, and have low permanent set or good cold flow resistance. These properties, coupled with the fact that a wide range of hardnesses can be made, indicate that Perbunan could be used as a press roll covering material for paper machines. A good roll cover must be well bonded to the metal core, must be resilient and resistant to cold flow, and have the proper hardness. Methods have been devised for adhering this rubber to metal. Numerous rolls have been made of the material, but it has not been used as a press roll cover for the reason that rubber is satisfactory, and also because Perbunan is more expensive, more difficult to process, and adhesion of plies presents a problem.

Synthetic rubbers might be considered by chemical engineers for many uses where natural rubber has sufficed

Decker couch rolls covered with Perbunan have worked very satisfactorily. Possibly the same technique would be applicable to large press rolls. It must be appreciated, however, that if attempts are made to use Perbunan or any other synthetic rubber in large rolls there will be numerous delays in delivery. No doubt many mistakes will be made before a synthetic rubber used as a press roll cover can approach the present high standard of performance of rubber covered press rolls.

It will take much time and effort to adopt the synthetic rubbers to all of the services of the process industries, meanwhile it is hoped that engineers will be sympathetic with rubber manufacturers. Real cooperation will be needed between the producer and user in order to solve the problems.

Perbunan has been used as a tank lining material as it is resistant to acids, alkalis, and water. Its electrical properties are not outstanding, but are good enough for many purposes. This rubber may be used for printers' rolls, motor mountings, conveyor belts, gasoline hose, packing, gaskets, and other products. The



Decker couch rolls covered with Perbunan have worked very satisfactorily. Possibly the same technique would be applicable to large press rolls

Germans say Buna reinforced with wire makes gaskets which seal better than asbestos and work well up to 350 deg. F. No doubt further uses can be made of it as more experience is gained. From the rubber manufacturer's standpoint, the chief drawback to this material is the difficulty in processing it, since it does not "break down" on a rubber mill in the same manner as rubber. Nevertheless, methods have been devised for handling it. It has excellent molding qualities.

Perbunan Extra is similar to Perbunan except that it is more oil resistant. It is a copolymer of butadiene and acrylonitrile in which a larger amount of the latter is used.

Hycar O.R. is derived from butadiene and an undisclosed ingredient. This synthetic rubber is similar to Perbunan, except that it is more resistant to oil. Like Perbunan it will yield vulcanizates with a wide range of hardness (Garey, Juve, Sauser, *Ind. & Eng. Chem.*, p. 602, 1941).

Specially compounded Hycar O.R. yields soft vulcanizates with excellent resistance to heat, both wet and dry. Hycar is less resilient than rubber but is sufficiently "rubbery" for many purposes. In spite of its low resiliency (in general), the stocks properly formulated show excellent resistance to cold flow. It tends to stiffen at low temperatures but can be formulated to give compounds which have good flexibility under this condition. Hycar O.R. is reported to give better wear value as a tire tread than natural rubber. It is outstanding in resistance to aliphatic oils. It has excellent molding qualities, can be calendered quite easily, and can be bonded to metal. This material has good resistance to acids, alkalis, and salt solutions (except strong oxidizing agents). Hence it can be used for all the applications previously given for Perbunan.

Buna S is a copolymer of butadiene and styrene and resembles natural rubber to some extent. It is not oil resistant, but does have good resistance to abrasion and chemicals, and good electrical properties. This synthetic rubber has been very little used for mechanical rubber goods, since it is not oil resistant, the principal attraction of synthetic rubbers heretofore. With a shortage of natural rubber, Buna S may become a very important synthetic rubber. It is capable of yielding vulcanizates of all degrees of hardness. These vulcanizates resemble compounds of similar hardness made from rubber with respect to chemical resistance and electrical properties. The electrical properties are superior to compounds of similar hardness made from Perbunan, Perbunan Extra, Hycar O.R., and the neoprenes.

Hard Buna S or Buna S-S could perhaps replace the usual products made of hard rubber such as combs, trays, bowling balls, syringe fittings, battery containers, etc.

Buna S can be bonded to metal satisfactorily and hence may prove useful as a tank or pipe lining material to replace rubber for all chemical solutions where rubber is now used, namely:

(a) All inorganic acids except strong oxidizing acids such as nitric and chromic

(b) All inorganic salt solutions except those which are strongly oxidizing

(c) Plating solutions

(d) Inorganic bases, such as sodium hydroxide

(e) Many organic acids, such as acetic, tartaric

(f) Pickling solutions

(g) Chlorine water and hypochlorite solutions

These possibilities for synthetic rubber are of interest to many industries. For example, rubber-lined tanks are widely used for pickling steel. The rubber is protected by a brick lining. In the case of stainless steel pickling where nitric acid is used special rubber compounds are required, and rubber coated with plasticized polyvinyl chloride is considered superior in performance to the conventional types of rubber lining. Synthetic rubbers, especially neoprene and Buna S could perhaps be adapted to this service either alone or in combination with other materials.

Transportation and storage of various acids now handled with rubber-

Comparison of Properties of Synthetic Rubbers

Rubber	Yields soft or hard rubber	Chemical Resistance	Oil Resistance	Electrical Properties	Abrasion Resistance	Heat Resistance	Cold Flow Resistance	Aging
Natural	All hardnesses	Good	Very poor	Good	Good	Medium	Good	Fair
Neoprene	Soft only	Good	Fair	Fair	Good	Good	Fair	Good
Perbunan	All hardnesses	Fair	Excellent to aliphatic hydrocarbons	Fair	Good	Good	Good	Good
Hycar O.R.	All hardnesses	Fair	Outstanding toward aliphatic oils	Fair	Good	Good	Good	Good
Thiokol	Soft only	Good	Excellent toward aro. and ali.	Fair	Poor	Poor	Poor	Excellent
Butyl	Soft only	Excellent	Poor, fair to vegetable oils and fatty acids	Excellent	Fair	Excellent	Fair	Excellent
Buna S	All hardnesses	Good	Poor	Excellent	Good	Good	Good	Good

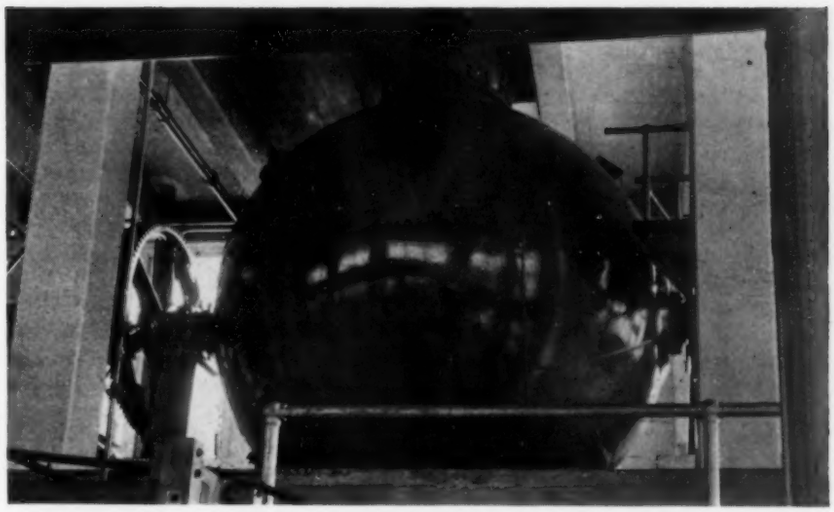
lined equipment could be handled with synthetic rubber. Discoloration of certain acids by contact with the synthetics is a problem which should receive special attention.

The plating industry makes extensive use of rubber-lined tanks, while the synthetic rubbers appear to have been little used for these tanks, some of the synthetics especially neoprene and Buna S have the necessary resistance to water and to the plating solutions. Adapting one or more of the synthetics would involve test to determine whether or not plating baths would be "poisoned." It seems probable that in most cases the synthetics could be so compounded as to avoid harmful contamination of the bath.

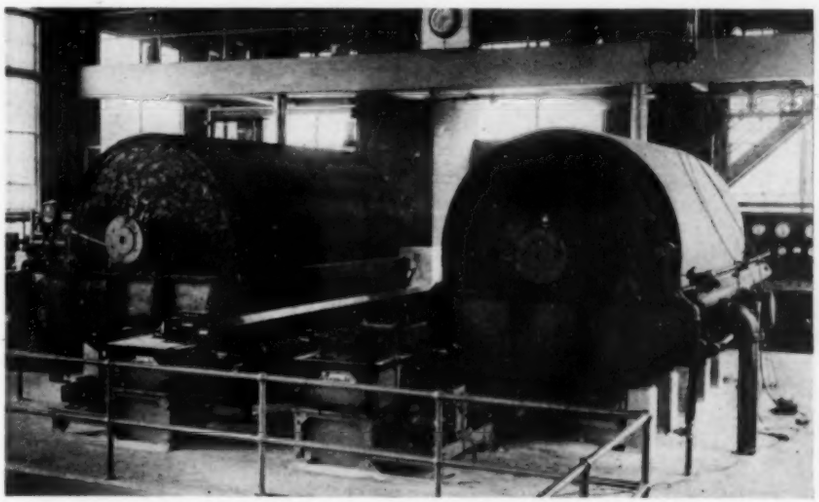
In general, synthetics have been used in the chemical industry only where an oil or severe heat condition exists. Obviously, they might be considered in many instances where natural rubber has sufficed. For best resistance to hot aqueous solutions, where oil is not a factor, neoprene (specially formulated) or Buna S would be preferable to the oil resistant Buna types. Due to its better aging characteristics it is possible that Buna S might prove superior to rubber in certain of the possible applications indicated.

There are a number of polysulphide rubbers known under the trade name of Thiokol. They are made from an organic dihalide and sodium polysulphide. This group is best known for its exceptional resistance to oils—both aliphatic and aromatic. They are quite resilient but have poor resistance to high temperatures and severe mechanical stresses. Thiokols are excellent for hose, printers' rolls, gaskets, self-sealing gasoline tanks, and many other mechanical goods where good resistance to oil is demanded. Their use can be greatly extended if necessary during the present emergency. They are not good at high temperatures and will not withstand severe mechanical stresses.

From this discussion of the commercial varieties of synthetic rubber it is apparent that if all were available in quantity, rubber manufacturers could make many of the articles which are now made of rubber. Some of the synthetic articles would be better, and some would be poorer than the same articles made of natural rubber. Further investigations of the processing and compounding will make it possible to meet most of the important requirement with synthetic rubber.

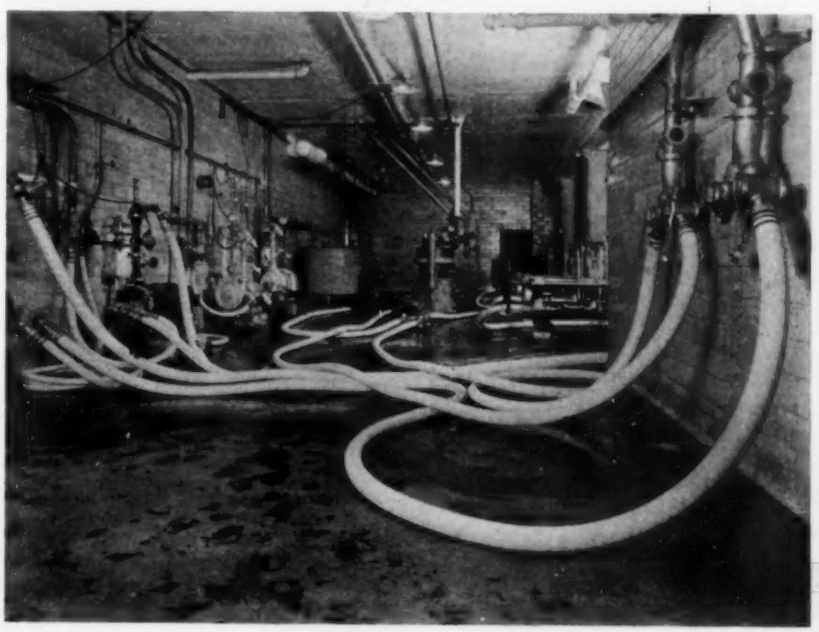


Flax straw pulp is bleached in this rubber-lined sphere in the cigarette paper mill of Ecusta Paper Co. at Pisgah Forest, N. C.



Rubber in this equipment must resist the action of ferric chloride, one of the most corrosive of chemicals

Synthetic rubber hose has been manufactured for several years



In the accompanying table have been listed the principal rubbers as well as natural rubber. From this table it should be possible to choose the synthetic rubber best suited for a given condition. It must be understood, of course, that the tabulation of properties is quite general and specific compounding of any one of the synthetic rubbers might give it a different rating with respect to the specific property listed.

Synthetic rubber hose has been manufactured for several years, and has been used largely for handling gas or oil. This same hose could be made and used for handling water, acids, and alkalis. Neoprene would be preferred for high temperature work or where exceptional water resistance is a factor. Thiokol is suitable for low-temperature work for many services. The Buna types could perhaps be adapted to hose manufacture if necessary.

Suction hose could be fabricated from the synthetic rubbers.

Conveyor belts are widely used in the paper industry for conveying chips, pulp, and not infrequently for transporting logs to and from barking drums. Coal is also moved on conveyor belts in the paper and other industries. Belts for these services are made in various widths and plies and are rubber covered (all around) to prevent water from entering the carcass and in order to protect from impact, gouging, and tearing, and to provide a surface at all points that will give maximum wear value. Synthetic rubber compounds have been developed out of which good conveyor belts can be made, in fact many have already been made, especially with neoprene.

Transmission belts in the paper industry are used for main line shafts of drive and various general power transmission drives such as found on thrashers, pumps and beaters. Here again synthetic rubber compounds can be used in place of natural rubber; and in cases where oil is present or where high temperatures exist the synthetic can be used to advantage.

The continuous bleaching of pulp has resulted in a very extensive use of rubber in certain paper mills, chlorine and hypochlorite solutions may conveniently be handled in rubber-lined pipe and tanks in this continuous bleaching operation. Vacuum washers are rubber covered, usually with rubber of a hardness from 10-20 plastometer. Compounds of suitable hardness, resiliency, and with sufficient resistance to heat and chemicals can readily be fabricated from the Buna types of rubber. Some difficulties would perhaps arise in applying synthetics here, but this type of equipment could perhaps be adequately protected with synthetics as more is learned about processing.

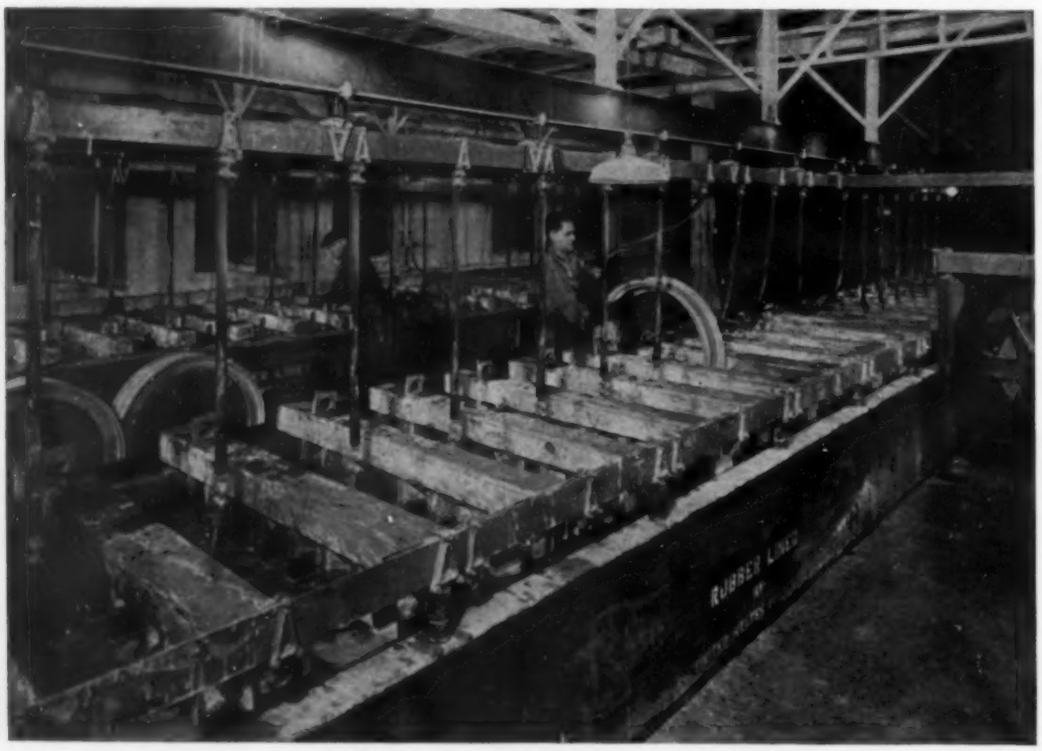
From the foregoing discussion it appears that it would be possible to make many pieces of equipment from one or more of the synthetic rubbers. What difficulties will be encountered in producing all of these articles, and how they will perform as compared with natural rubber, for the most part, remains to be seen.

Styrene can be produced for 30-35c. per lb. and acrylonitrile at 35c. On a large tonnage basis, butadiene could be made for 10-15c. per lb. and the finished Buna type rubbers for 20-25c. per lb. H. I. Cramer, Sharples Chemicals, has prepared an interesting tabulation showing at what prices the various synthetic rubbers will have to sell in order to compete with natural rubber at prices prevailing before our entering the war (*Chem. & Met.*, p. 150, Jan. 1942).

Under present conditions a synthetic rubber would not have to compete in price with natural rubber. If suitable for a vital industrial need a synthetic rubber could sell for several times the price of crude natural rubber and could sell in large volume. It seems likely that in a free market rubber could still sell for a price well below any of the synthetic rubbers.

The author wishes to thank his associates, O. S. True and E. D. Hoff, for assistance in the preparation of this paper.

Neoprene and Buna S have the necessary resistance to water and to plating solutions to be used for the tank lining



Mobilizing Petroleum Hydrocarbons

GEORGE F. FITZGERALD *Chemical Engineer, Olean, N. Y.*

***Chem. & Met.* INTERPRETATION**

The petroleum industry, mobilizing its hydrocarbons for use in high-octane aviation fuel, synthetic rubbers, toluene and other products, will play a vital part in the winning of this war. Just how capable and prepared is the country's largest process industry to meet these new responsibilities? Can the industry supply by 1943 sufficient raw materials for some 600,000 tons of synthetic rubber and 65 million barrels of 100-octane aviation fuel? Herein the author answers this question and gives some interesting aspects of the problem.—*Editors.*

DEMAND FOR petroleum products in 1941 was the greatest in the 80-year history of the industry and exceeded the previous year by ten percent. At the end of last year, daily crude oil production had reached 4,100,000 bbl. Output is expected to reach 4,500,000 bbl. by the middle of this year and five million by July 1943. In the face of an acute rubber shortage, it is interesting to speculate that one day's crude oil production is equivalent on a hydrocarbon basis to our annual crude rubber consumption.

The Far Eastern situation now presents the oil refining industry with a formidable proposition. Will it be possible to guarantee adequate stocks of 100-octane aviation gasoline and, in addition, meet an entirely new demand for synthetic rubber ingredients? It must be remembered that American refineries are supplying fuel to all the Allied nations as well as to our own greatly expanded air forces.

The superiority of 100-octane fuel has won it complete acceptance by all fighting forces. Weight for weight, it yields 20-25 percent more power than 90-octane fuel. This means lighter fuel load and lighter engines per delivered horsepower. These advantages permit higher operating speeds, bigger pay loads and wider radius of operation. In spite of these advantages the suggestion has been made that aviation fuel quality be dropped to 90-octane to release stocks for synthetic rubber.

American 100-plus octane fuel is a blend of light straight-run petroleum fractions, alkylation products and catalytically cracked gasolines plus tetraethyl lead. Aromatics also might come into use as they have been found satisfactory in England. According to Refining Director W. W. Gary, an acceptable fighting grade fuel for the Army and Navy may be 100 or 100-plus octane rating to be blended approximately as shown in Table I.

FIGHTING GRADE FUEL

Before Pearl Harbor, the Office of Petroleum Coordinator estimated that our defense program would require the expansion of fighting grade fuel capacity to 126,000 bbl. per day before the end of 1942. A month later the figure was raised to 180,000 bbl. per day. By contrast, last year's output reached a peak between 45,000 and 50,000 bbl. per day, which is more than all the rest of the world produces. The OPC has concentrated on making every move count toward increasing output and capacity at the utmost speed. One of its most important efforts was the Petroleum Hydrocarbon Survey which determined the quantities and types of hydrocarbons available from the oil industry. These figures will be of especial value now in locating sources of high-octane fuel, butadiene and styrene.

The call for synthetic rubber bases from petroleum sources momentarily appears to jeopardize the output of 100-octane gasoline. To arrive at an understanding of the situation as it affects the refiners requires an analysis of wartime demand for rubber and fuel and a study of potential and actual sources of raw materials suitable for both. It is the purpose of this article to outline the processes and capacities available for the manufacture of butadiene and fighting grade aviation gasoline.

According to Table I we would need approximately 90,000 bbl. per day of 80-100 octane blending agents to meet the OPC program. Of this amount about half might come from catalytically cracked gasoline and the rest from alkylates and hydrocodimers. The latter two stocks must be made from butane bases and consequently will be in direct competition with raw materials for synthetic rubber.

Principal sources of butane and isobutane are the natural gasoline and gas recycling plants of the Southwest. Vast quantities of petroleum gases from the high pressure fields are passed through absorption towers and fractionating columns to remove "natural" gasoline and the C_3, C_4, and C_5 fractions. Typical analyses are shown in Table II. The lean gas from these recycling plants is returned to the oil-bearing sands to help maintain reservoir pressure. This country's 160-odd natural gasoline plants alone when operating at full capacity can turn out approximately 2,000,000 gal.[1] of butane-propane mixture daily. Refineries also produce large volumes of these gases but usually not enough even for their own blending needs. Texas has 58 plants which produce 43 percent of the country's output of liquefied petroleum gases. In 1939 the total was 223,500,000 gal. which rose to 300,000,000 gal. in 1940 or a gain of 32 percent. The bulk of propanes and butane now go to the bottled gas markets and into industrial fuel. It is in domestic use that they are most apt to be curtailed for government purposes. In 1941 there were over a million retail customers for bottled gas. The potential liquefied

Table I—Typical 100-Octane Gasoline Blend

50% blending agent (88-100 octane)
40% base stocks (75 octane)
10% isopentane

Tetraethyl lead content not to exceed 3 cc. per gal.

petroleum gas supply is in the neighborhood of 33,000,000 gal. per day.

The largest condensate recovery recycling plant in the world[2] recently completed in Texas handles 225,000,000 cu. ft. of gas daily. The original plan called for recovering 50 percent of the available butane and isobutane content but the expanded armament program made it advisable to increase the design yield to 85 percent. Building more such plants and greatly increasing crude runs are not necessarily the answers to wartime demands. Existing absorption plants could increase their yields by modernization and improved supervision. By so doing they could make available upwards of 30,000 bbl. per day additional butane. The noticeable decline in domestic consumption of motor fuel plus the proposed reduction of its butane content will release almost twice as much more. As in most manufacturing fields, the systematic reduction of waste will result in important savings.

MIXED BUTANES

Such measures could make available 90,000-125,000 bbl.[3] per day of mixed butanes in less time and more economically than by building entirely new plants. The technical problems involved are by no means difficult. The chief obstacle is the time element in erecting sufficient rectification and absorption equipment to modernize the existing plants and augment their output. In converting these butanes to alkylates and hydrocodimers for aviation fuel heavy losses are encountered. On the basis of an approximate 60 percent overall yield 75,000 bbl. per day would be sufficient for 45,000 bbl. of high-octane blending agents. By difference, then, there should be from 15,000-45,000 bbl. per day of butane available for rubber production.

Amount of synthetic rubber needed may best be gaged by considering our normal consumption of crude rubber. In 1940 the value of all manufactured rubber goods reached $940,000,000 while the crude rubber demand exceeded 600,000 long tons.[4] With conservation measures now in effect, the estimated maximum of 800,000 long tons for 1941 is expected to drop to about 400,000 tons by the end of 1942.

Table II
Raw Midcontinent Petroleum Gas
Typical Percentage Analyses

	A	B
Methane	2.50	2.75
Ethane	7.50	9.25
Propane	21.60	10.70
Isobutane	5.00	8.00
n-Butane	27.00	34.00
Pentane and heavier	36.40	35.30

CRUDE RUBBER STOCKS

In a recent statement Jesse Jones, Secretary of Commerce, announced[5] that our stockpile of crude rubber was over a million tons or about two year's supply for army and navy needs. The United States received about 114,000 tons from the Far East in January and a similar amount in transit was expected to arrive here in February. Naturally no further shipments from Malaya will be made while the Japs are in possession. Reclaimed rubber up to 50 percent is used to extend the crude supply, but our scrap pile will last only 12-18 months with tire rationing in effect.

These figures definitely show that we have approximately a year and a half in which to improve our rubber output. Guayule from the Mexican shrub has been advanced as a possible solution. We now obtain about 4,000 tons of guayule annually but four to six years would elapse before that figure could be substantially increased. South American rubber production likewise calls for long-term development with no immediate increase in tonnage. We are brought abruptly to the realization that synthetic rubber must meet the demand and that *synthetic production must be stepped up to 300,000–400,000 tons for war purposes alone in much less than two years.*

SYNTHETIC RUBBERS

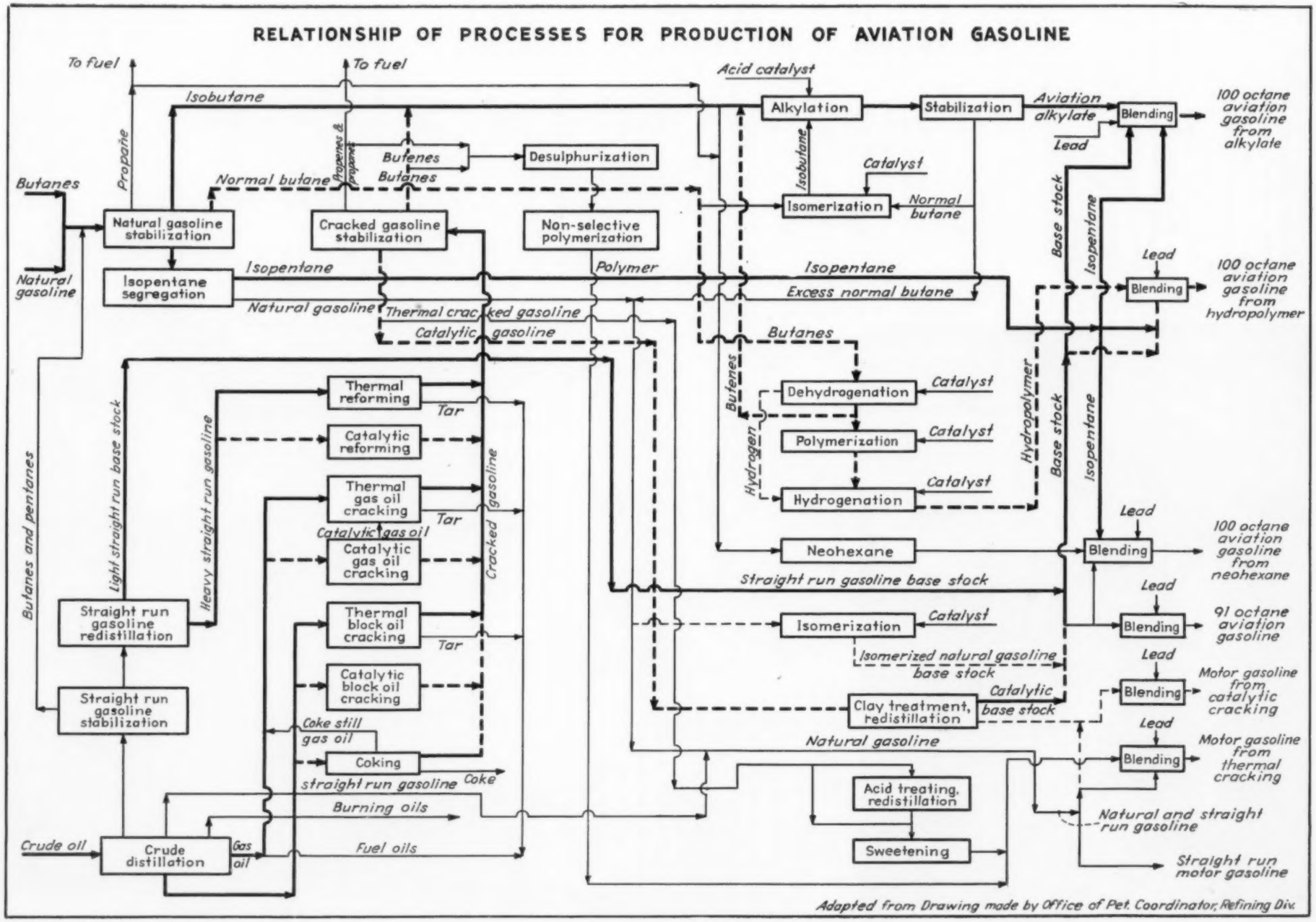
It is outside the scope of this article to discuss synthetic rubber production from the process angle. Our concern is with the types and quantities of raw materials needed with particular emphasis on petroleum derivatives. With several commercial types of synthetic rubber on the market, the government is depending largely on the neoprenes and the butadiene polymers because of their superior wear characteristics. For military purposes in general rubber must meet the requirements of good tire tread material. In this respect thiokol, polysulfide rubbers, polyisobutylenes and others, while very important in specialized fields, are not equal to chlorprenes and butadiene polymers. In its $400,000,000 building program, the government is putting the greatest emphasis on the butadienes. The "Buna S" type has been adopted as standard for war production. The butadiene is produced from petroleum, natural gas, alcohol or acetylene. The styrene can be made from benzol derived from coke-oven operations.

Dr. E. R. Weidlein, Consultant, Chemicals Branch of WPB, announced to the oil industry in February that it was necessary to pool all patents, resources and technical experience with the rubber and chemical manufacturers if we are to carry out the rubber program. He stated that raw materials for the first half of that program are in sight and are to come largely from chemical industry. For the second 200,000 tons the petroleum industry is expected to furnish the necessary base stocks.

It is obvious that an abundant supply of acetylene, butadiene and styrene will be needed to expand synthetic rubber production from an estimated 90,000 tons before this year is over to 400,000 tons per year in the next 18 months. The latter quantity is equivalent to a theoretical consumption of 11,000 bbl. of butane per day. This is well within the balance of 15,000–45,000 bbl. left after earmarking sufficient amounts for 100-octane gasoline production. As would be expected, however, theoretical yields are not obtained. High conversion losses and side reactions will probably bring the ultimate demand up to 35,000 bbl. per day[3] or very close to our working balance. This demand, of course, will be reduced to the extent that sizable amounts of rubber will be produced from bases other than butadiene. Should unforseen circumstances require much additional butane it would be necessary to build additional butane recovery plants and further restrict civilian supplies. One possibility which is feasible but probably not strategically sound is the reduction of fighting grade gasoline to 90-95 octane rating. This would release 70,000-80,000 bbl. of butane per day. Such a step would call for a military choice between rubber and 100-octane fuel.

ACETYLENE AND BUTADIENE

Acetylene production from petroleum is under development by research workers at the University of Texas. They report that it has been made experimentally from propane but has not yet reached the commercial stage. Existing facilities for the synthesis of butadiene from petroleum gases are being rapidly augmented. Typical of the new facilities is a 5,000 ton-per-year unit which went into production late in 1941. Several more plants are under construction but details must be considered as military secrets at this time.


RELATIONSHIP OF PROCESSES FOR PRODUCTION OF AVIATION GASOLINE
To fuel
To fuel
Acid catalyst
Isobutane
Alkylation
Stabilization
Aviation alkylate
Blending
100 octane aviation gasoline from alkylate
Lead
Propane
Propenes & propane
Butenes
Desulphurization
Butanes
Normal butane
Butanes
Catalyst
Isomerization
Normal butane
Isobutane
Base stock
Isopentane
Natural gasoline stabilization
Cracked gasoline stabilization
Non-selective polymerization
Natural gasoline
Isopentane segregation
Isopentane
Polymer
Isopentane
Lead
Blending
100 octane aviation gasoline from hydropolymer
Excess normal butane
Natural gasoline
Thermal cracked gasoline
Catalytic gasoline
Butanes
Butenes
Dehydrogenation
Catalyst
Hydrogen
Polymerization
Catalyst
Hydrogenation
Catalyst
Hydropolymer
Base stock
Isopentane
Thermal reforming
Tar
Catalytic reforming
Thermal gas oil cracking
Tar
Catalytic gas oil
Catalytic gas oil cracking
Cracked gasoline
Light straight run base stock
Heavy straight run gasoline
Butanes and pentanes
Neohexane
Lead
Blending
100 octane aviation gasoline from neohexane
Straight run gasoline base stock
Straight run gasoline redistillation
Thermal block oil cracking
Tar
Isomerization
Catalyst
Lead
Blending
91 octane aviation gasoline
Isomerized natural gasoline base stock
Catalytic block oil cracking
Straight run gasoline stabilization
Clay treatment, redistillation
Catalytic base stock
Lead
Blending
Motor gasoline from catalytic cracking
Coke still gas oil
Coking
Natural gasoline
Lead
Blending
Motor gasoline from thermal cracking
straight run gasoline
Coke
Acid treating, redistillation
Burning oils
Natural and straight run gasoline
Crude oil
Crude distillation
Gas oil
Fuel oils
Sweetening
Straight run motor gasoline
Adapted from Drawing made by Office of Pet. Coordinator, Refining Div.

Courtesy Robert Yarnall Richie

100-octane fighting fuel can be made by catalytic alkylation of iso-butane and butene to iso-octane in plants like the one shown here

Many of the steps involved in butadiene synthesis are familiar to manufacturers of 100-octane gasoline, who for years have been using a series of thermal and catalytic processes[7]. It may be of interest to summarize these and note parallel applications. Both reforming and cracking convert butane to butylene, which may be further dehydrogenated to butadiene. Or it may be combined with an olefin by alkylation for a high-octane blending agent. The necessary butane is obtained by absorption and fractionation from natural gas and refinery cracking still gases. In the latter case isobutane and butylene are also recovered. Hydroforming combines dehydrogenation with aromatization, using straight run or catalytically cracked naphthas as charging stock. The conversion takes place in an atmosphere of hydrogen at elevated temperatures and pressures. The product represents an 80 percent yield of 80-octane gasoline containing a high percentage of aromatics. Operating conditions can be modified so as to produce 80 percent aromatics rich in toluene. Polyforming is an analogous process which uses butane or propane vapors instead of hydrogen.

Alkylation comprises joining an iso-paraffin with an olefin (unsaturated) hydrocarbon. If iso-butane and butylene are taken as charging stocks the product is iso-octane, the most important available blending agent for 100-octane aviation gasoline. The catalyst is 100 percent sulphuric acid and the charge usually consists of the butane-butylene mixture from a cracking or dehydrogenation plant plus additional isobutane from an absorption plant or an isomerization process. Sulphuric acid alkylation was developed almost simultaneously by several companies who have pooled their interests. The process is the best available for a high yield of 100-octane fuel per unit charge of olefin. Pyrolytic alkylation of ethylene-butane mixtures yields neohexane which tests 94 octane without lead and 115 octane number after the addition of 3 cc. tetraethyl lead per gal. of gasoline.[10]

ISOMERIZATION

Isomerization is a very important adjunct to alkylation. In relation to our present discussion, this is the factor which puts aviation gasoline in close competition with synthetic rubber for the available butane supply. Refinery gases as fed to an alkylation plant are usually deficient in isobutane and often too rich in n-butane, which acts as a diluent. Normal butane from many sources is relatively abundant but was useless in alkylation until the perfection of the isomerization process for converting it to the active branched-chain form. Until that time a limited amount was blended into gasoline and the greater part went to the bottled gas market. In commercial operation the process results in almost complete conversion of normal butane to isobutane. Butane vapors mixed with dry hydrogen chloride gas are passed through a chamber packed with an aluminum chloride catalyst supported on inert granular material. The hydrogen chloride serves to activate the catalyst and is entirely removed from the finished product. The reaction product is passed through a refrigerated condenser and thence to a hydrogen chloride stripping column. The acid vapors are recycled to the process and the acid-free bottoms are ready for alkylation.

CATALYTIC POLYMERIZATION

Catalytic polymerization is commercially applied to propylene and the butylenes to form liquids in the gasoline boiling range. Phosphoric acid and copper pyrophosphate are most widely used as catalysts. Operating temperatures range from 300-400 deg. F under pressures from 700-1,100 lb. depending upon the particular process in use. The pre-heated charge is fed to the catalyst chamber and then to a stabilizer unit where the desired product is fractionated. Catalyst temperatures must be closely controlled. Two catalyst chambers are provided so that one may be dumped and recharged while the other is in service. Exhausted catalyst is discarded. Catalyst life averages 90 gal. of polymer per pound of catalyst with 85-95 percent conversion to a product which tests 84 octane but has a blending value equal to 110-130 octane rating.

CATALYTIC CRACKING

Houdry catalytic cracking gives high yields of 80-octane gasoline from distillate fuel oil (gas oil). The product, which is highly suitable for blending to 100-octane, is obtained without drawing upon our vital supply of butanes and butylenes. Catalytic dehydrogenation is applicable to both synthetic rubber and aviation fuel. It is of immense importance for increasing our supply of selected olefins. Of these latter, ethylene from ethane is thermally alkylated to neohexane as already pointed out.

Table III—Derivation of Principal Synthetic Rubbers

Synthetic Rubber	Principal Raw Materials
Buna S	Butadiene Styrene
Buna N (Hycar) (Chemigum)	Butadiene Acrylonitrile
Butyl	Butadiene Isobutylene
Neoprene	Chloroprene
Vistanex	Isobutylene
Koroseal	Vinyl chloride
Thiokol A	Ethylene dichloride Sodium tetrasulphide
Thiokol B	Dichlorethyl ether Sodium tetrasulphide

Table IV—Relationship of the Petroleum Industry to Synthetic Rubber Intermediates and Raw Materials [1]

Synthetic Rubber Intermediate	Raw Material	Source of Raw Material
Butadiene	Butane	Natural or petroleum refinery gases.
	Ethanol	Ethylene, fermentation, etc.
	———	Cracked petroleum gases.
Styrene	Ethylene, benzene	Natural or petroleum refinery gases; coal gases.
	———	Cracked petroleum gases.
	———	Carburetted water gas light oils.
Acrylonitrile	Ethylene	Natural or petroleum refinery gases.
	Acetylene	Natural or petroleum gases; calcium carbide.
Isobutylene	———	Cracked petroleum or natural gases.
Chloroprene	Acetylene	Natural or petroleum gases; calcium carbide.
Ethylene dichloride	Ethylene	Cracked petroleum or natural gases.
Vinyl chloride	Ethylene	Cracked petroleum or natural gases.

[1] Compiled from various sources by the editors.

Isobutylene charged to the hydrocodimer process is first condensed to isooctenes, which are then hydrogenated to isooctanes. Butane to butylene to butadiene are the dehydrogenation steps of interest to the rubber manufacturer.

The national armament program necessarily prohibits publication of much recent process development. These undisclosed advances in the art of refining will doubtless reveal petroleum as the raw material for an entirely new branch of chemical industry. For the present we are content with news of improvements in existing processes and general reports of building projects. More than a score of 100-octane plants are under construction. They are the start in the program to triple or quadruple our current production of approximately 50,000 bbl. per day. Incomplete totals in January[8, 9] indicated over $150,000,000 worth of projects under construction which would add at least 40,000 bbl. per day to our capacity for fighting grade aviation fuel. Several government construction loans are to be repaid by turning over the entire output to the United States at 12–13 cents per gal. Other plants now building are to produce isobutane, thermally cracked gasoline, polyformed gasoline, isopentane and butadiene but no details are available.

CONCLUSIONS

All industry is being enlisted to further the national armament program. The petroleum world, with its vast production of essential war materials, has consistently shown remarkable foresight. It has kept fully prepared to meet any likely demand from our fighting forces. At any one time in the past few years our aviation fuel capacity was more than ample for our needs. Even today we have more aviation fuel on hand than we had a year ago. Export of fighting grades of fuels was controlled in full cooperation with government agencies.

Demand for synthetic rubber has put an unexpected burden upon the petroleum industry. The production of 100-octane gasoline must be rapidly increased. Sufficient isobutane, butadiene, high octane blending agents and other strategic petroleum derivatives must be provided to carry on the war production program. Existing capacities for these materials must be expanded 300, 400, and in some cases even 500 percent to meet the demand of our armed forces.

This program was given a boost in December when five oil companies owning patents on processes of manufacturing aviation gasoline agreed to reduce their royalties by 50 percent or to 21 cents per bbl.

The call of the government for increased supplies of essential petroleum products will be met. The oil industry's unique position as the only branch of American industry prepared for war when hostilities broke out is the guarantee of that statement. Oil refiners have reason to be proud of their development of aviation fuel processes and of their foresight in building capacity which enables this country to have more 100-octane fuel on hand today than was in stock a year ago. Figures and estimates are given to show how vital materials such as butane can be supplied in sufficient amounts for synthetic rubber production without reducing the output of aviation gasoline or seriously reducing civilian supplies.

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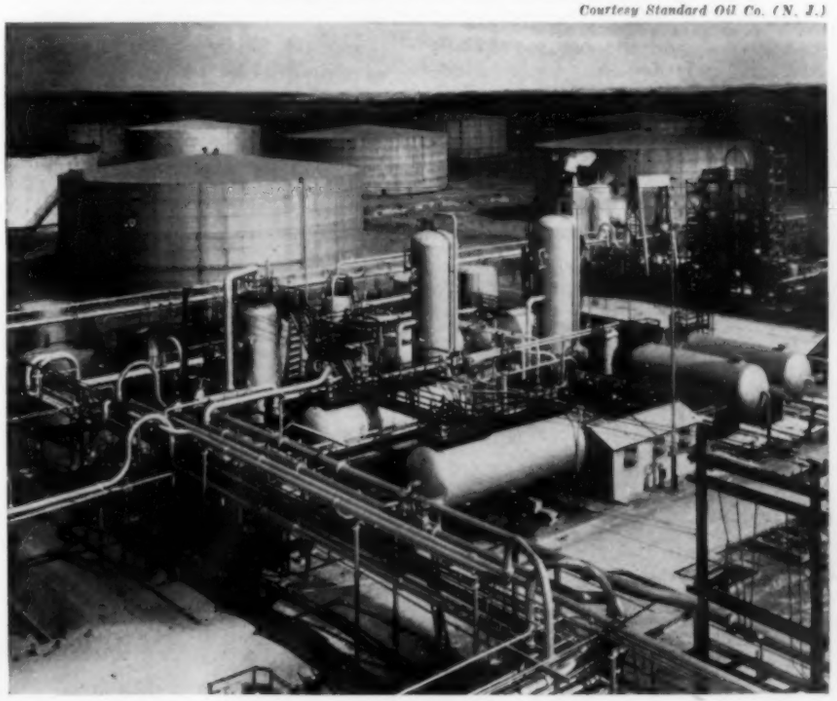
Close-up view of an alkylation plant at Baytown, Texas. In this unit waste refinery gases are utilized to produce a blending agent for use in making high octane aviation gasoline (see flow diagram on page 85)

Courtesy Standard Oil Co. (N. J.)



How to Conserve Rubber Equipment

O. S. TRUE, *United States Rubber Co., New York, N. Y.*

Chem. & Met. INTERPRETATION

In view of the present difficulty of securing almost every type of material of construction it behooves the manufacturer to prolong the life of the equipment which he now has by every means at his command. Because of this serious situation the author's suggestions for the protection of rubber linings in tanks, valves and other pieces of equipment are particularly timely.—*Editors.*

IN THE NATIONAL EMERGENCY the United States Rubber Co. has recognized the principle that "every ounce of rubber is a sacred trust." Because of the important part played by this material in the war effort, it becomes the duty of every one to conserve rubber by the proper care of their industrial equipment in which it is used. In the chemical industry there is an unusual opportunity to observe this duty and at the same time to effect production savings through more efficient maintenance of rubber linings.

In the planning which precedes the actual installation of rubber-lined equipment, the engineer should be careful to give the rubber manufacturer full and accurate information concerning service conditions. Specifications for rubber linings differ appreciably and the life of any installation may depend greatly on the completeness of the original data.

In the erection of large rubber-lined tanks it is important to take special precautions against damage to the linings. Riggers' slings must be well padded at the point of contact between rope and tank lining. If it is necessary to enter the tank, workmen should wear rubber-soled shoes to avoid abrading and cutting the lining. Care must be taken against the possibility of welding sparks or tools dropping into the tank from construction overhead.

Rubber-lined pipe and fittings should be assembled with care to see that there are no excessive strains on the rubber over the faces of flanges. Only the gaskets that are supplied should be used. There will be soft, pure gum for hard-rubber-lined pipe, and for soft-rubber-lined pipe. Pipe sections should be aligned and bolts brought up evenly with a standard open-end wrench. A bar or hammer should not be used. The pipe should be supported to prevent bending and necessary provision should be made for expansion and contraction in the line. This can be accomplished best by using flexible expansion joints.

If there is a possibility of mechanical damage to rubber-lined equipment, the lining should be protected by wood bumper strips or brick linings set with acid-proof cement. Hard-rubber lined equipment should be protected against external shock—particularly in cold weather.

Efforts to increase production frequently result in higher operating temperatures. If production is being pushed, it is advisable to investigate the possible effect of these higher temperatures on any rubber-lined equipment which may be in the flow-sheet. High temperature in general shortens the life of rubber and under certain chemical conditions a small temperature increase may be beyond a safe operating point and result in rapid deterioration of rubber linings.

It is a good policy to call in a sales engineer from a rubber company for consultation before making these changes and be guided by his recommendations. He may suggest a supplementary inner lining of brick and acid-proof cement which will create a temperature gradient between solution and rubber lining. This often makes possible the use of rubber under conditions it could not stand without the protection.

In some cases shortages of raw materials are making it necessary to use substitutes or to change processes substantially. Either of these things may result in a radical change of operating conditions for some or all of

An operator should wear rubber-soled shoes when entering a rubber-lined tank to protect the lining from abrasion

When changing plating solutions remember that linings suitable for nickel can not cope with conditions in a copper bath

It is a good policy to consult a representative of a rubber company before making changes in operating conditions

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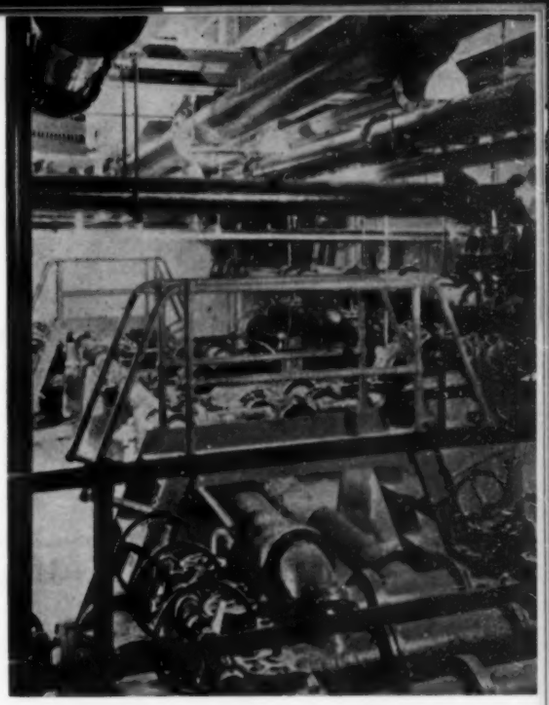
Rubber-lined pipe and fittings should be assembled with care to see that there are no excessive strains on the rubber over the faces of flanges



the rubber-lined equipment. Since the original specifications of the linings were made to suit a different set of circumstances it will be best to consult with the sales engineeer before making the proposed changes. For example, numerous nickel plating operations have been changed over to copper. But a lot of tank linings that are suitable for nickel can not cope with the conditions encountered in a copper bath.

Increases or changes in production procedure which in themselves might not jeopardize rubber lining may possibly result in an increased concentration of impurities or in the production of other impurities detrimental to rubber. If this problem arises, the sales engineer from the rubber company can undoubtedly make helpful recommendations.

Many rubber-lined tanks contain solutions of extremely corrosive materials of high specific gravity but in concentrations low enough not to attack rubber lining. If such tanks are used for mixing, the operator should be sure that there is sufficient agitation to avoid stratification. If this happens, there is danger to the lower portions of the tank where inspection can not reveal the hazard until it is too late. For example, if 66 deg. Baumé sulphuric acid is added to a solution without agitation it will sink immediately to the bottom of the tank and shortly destroy the lining in that area.

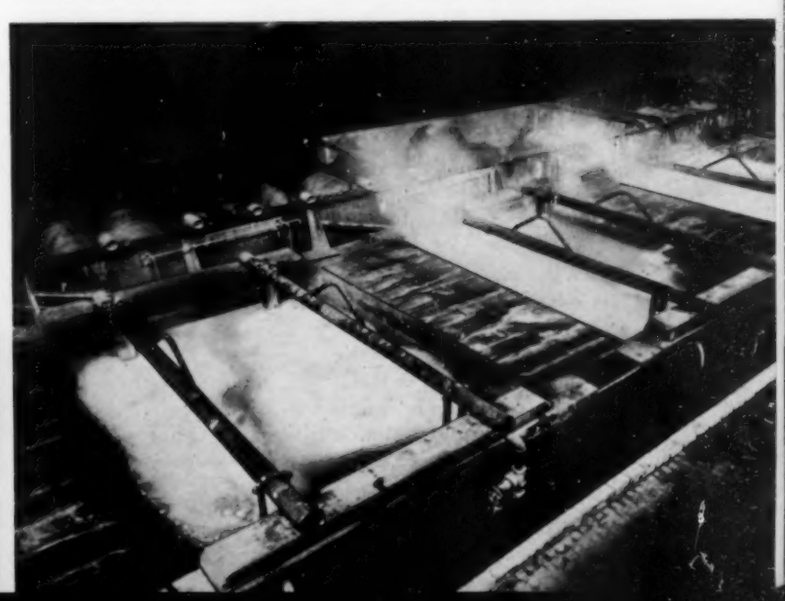
Rubber-lined valves should not be closed under excessive pressure when in service since this tends to crack and destroy the lining.

Operators making routine examinations or cleaning rubber-lined tanks should protect the linings from abrasion or cutting by wearing rubber-soled shoes. Points of lubrication on adjoining or overhead equipment should be protected so that lubricants will not drop into the tank or be brought in contact with the rubber lining as natural rubber is damaged by oil. Any damage which may accidentally occur to rubber linings must be repaired at once, and periodic examination should be made so that even the smallest cut will be discovered quickly. This will not only protect the lining against further damage but will also save metal parts of the equipment. Where steel tanks have large surfaces exposed to direct sunlight in warm climates, dark colored paint will cause them to absorb surprisingly large quantities of the heat and the operating temperature of the rubber lining will be unnecessarily high. Such tanks should be covered with light colored paint which will reflect a very large portion of the sun's heat.

If rubber-lined equipment is to be idle for any length of time, the lining should be submerged in a dilute acid solution. Dry air, sunlight, and heat are very detrimental to unprotected rubber linings. Rubber-lined valves which are to be idle should be opened, removed from the line, and carefully cleaned.

Proper care for the rubber linings of tanks such as these will extend their usefulness and thus conserve rubber

Give the rubber manufacturer full and accurate information concerning service conditions when ordering lined equipment



Centrifugal Pumps for Process Use

A. T. NIELSEN *Application Engineer, Worthington Pump & Machinery Corp., Harrison, N. J.*

Chem. & Met. INTERPRETATION

This paper, which was a prize winner in the Hydraulic Institute's recent Second Annual Engineering Contest, presents an exceptionally good picture of the way the centrifugal pump has developed to meet the peculiar requirements of process industries' uses. A number of extremely useful ideas for increasing the life of pumps operating under severe conditions, and for facilitating their inspection and maintenance, are presented. The paper is an important contribution in the series planned by *Chem. & Met.* to deal with the vital problem of making process equipment last longer.—*Editors.*

IN THE TWO DECADES following the first World War, the process industries have undergone tremendous growth. Increasing complexity in the industries' problems has demanded equipment peculiarly fitted to the requirements. Many of the raw, intermediate and finished materials handled are in liquid form so that process industries have placed many and varied demands upon the pump builders. Development of pumping equipment has followed the expected pattern, ranging from the early use or adaptation of existing designs (principally water pumps), to the point where demand arose for pumps especially suited for the work at hand. Handling of liquids of low viscosities of almost any character was found to be possible through refinement of the centrifugal pump.

Today the centrifugal pump is called upon in the handling an almost infinite variety of liquids. The problems incident to pumping of non-corrosive and non-abrasive liquids are generally well understood but where abrasive or corrosive materials are to be pumped, the best methods are not so well understood, and it is to the solution of such problems that the present paper is devoted.

Historically, it may be noted that severe liquid handling problems were first solved with simple containers and with blow cases or acid eggs. Not satisfied with these expedients, certain industries such as metal refining and electrochemical industries attempted to employ standard horizontal double-suction centrifugal pumps. Many difficulties were encountered with impeller corrosion and stuffing box troubles. Designers then decided on the vertical pump with the impeller at the bottom and the shaft within a tube extending above the liquid level. This move eliminated the troublesome stuffing box, but brought other problems in its stead. For example, to offset serious corrosion (generally from sulphuric acid and its salts), lead-lining of these pumps was resorted to. This move eliminated failure due to galvanic action. However, the double-suction type of impeller was poorly adapted to lead covering so that a single-suction open impeller was used. The unit thus constructed performed quite well and had few drawbacks but was expensive both to build and to operate, and quite inefficient. Still, such units were the best of their time and many sizes and style variations were developed.

Coincident with the development of the vertical pump, efforts were expended to solve the problem presented by the stuffing box in horizontal units when handling corrosive materials. With the advent of such inorganic packings as asbestos, the material so widely used today, it became possible to minimize the maintenance problem. Horizontal units were then constructed which, owing to their short impeller overhang on the shaft, permitted higher speeds, thus reducing power requirements compared with vertical pumps for similar service conditions.

About 15 years ago the metallurgical technique of the then new stainless steel alloys had reached the stage where moderately complicated

Fig. 1—Visual orifice for checking and regulating sealing water flow to centrifugal pump stuffing boxes

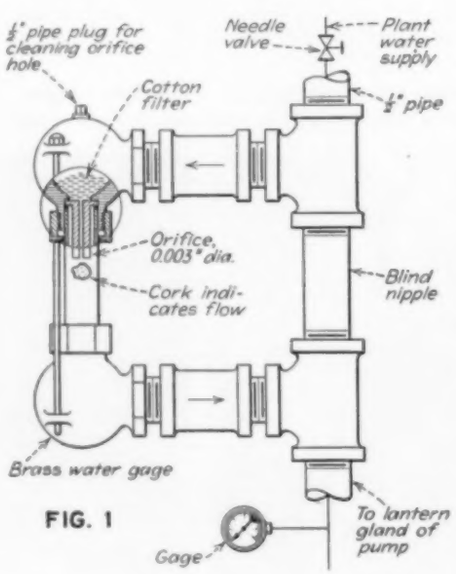


FIG. 1

Fig. 2—One means of handling stuffing boxes on high-head, closed-impeller centrifugal pumps

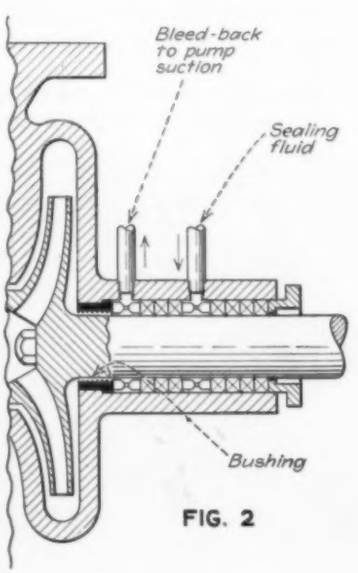


FIG. 2

shapes could be cast. Now the so-called "chemical pump" took an entirely new turn. Constructing centrifugal pumps of long-lived materials became commercially possible. In addition, other materials such as the high silicon irons and ceramics also became available, all giving pump builders new and useful construction mediums.

PRESENT-DAY TRENDS

The prime consideration in centrifugal pump design for process industry use is to give the user a unit at as low a first cost as is compatible with the desired life and required maintenance cost. The horizontal single-suction pump is the logical one to meet these needs. For chemical service the frame of such a pump must be rugged enough to prevent misalignment despite any load or stress imposed. The shaft and its means of support must be constructed so that no measurable deflection in use can take place in that portion upon which the impeller is hung. The reason for this is that the packings normally used in pumps for corrosive materials are of a non-resilient nature and hence have little tendency to "follow" a shaft rotating eccentrically. The logical conclusion is that the shaft should be supported on ball bearings, since the amount of radial displacement allowed by sleeve bearings—and necessary for their lubrication—is beyond that which can be tolerated by such packings.

To maintain the casing and impeller shapes at a minimum of complication, the single-end-suction pump finds wide favor and also requires but one stuffing box. A heavy shaft can be used as its dimensions do not affect the impeller inlet dimensions as with double-suction impellers. Extremely close fits within the pump proper can be avoided, thus preventing possibility of destructive rubbing contact and galling of high alloy steels.

High efficiency, often considered of prime importance in pump construction, is relatively unimportant in chemical pumps where long life and low maintenance are paramount qualities. Thus impeller vanes can be made heavier and more rugged than in water pumps and casing features such as wearing rings can be eliminated completely. Attainment of long life merely consists in simplifying the unit and increasing the ruggedness of its parts. The designer can, however, impart features very valuable to the ultimate user when the pump is so constructed that its maintenance will be low.

Fig. 3—Sealing water protects these stuffing boxes against abrasive pigment

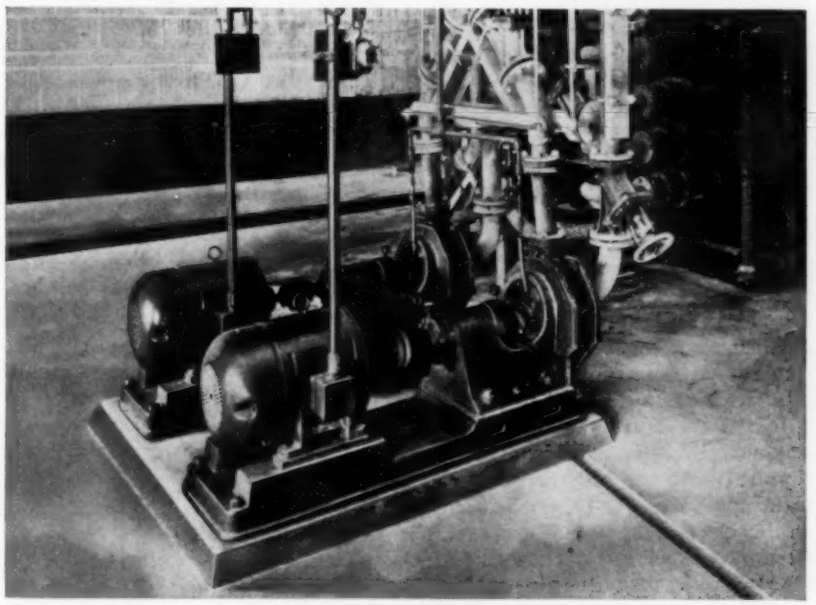
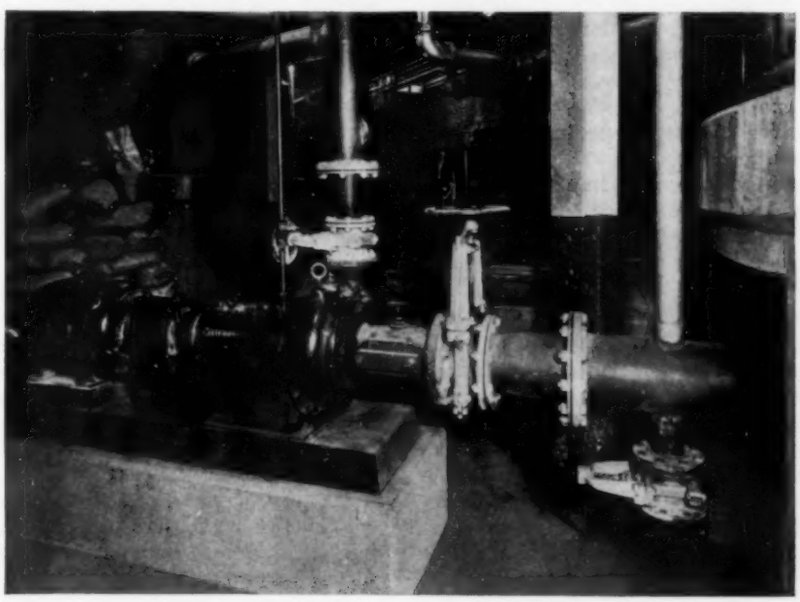


Fig. 4—Mounting pumps on elevated foundations in well-lighted locations facilitates inspection and maintenance in this large paper mill



STUFFING BOX POINTERS

Particularly is this true in the case of the stuffing box. The repacking of a chemical pump in service is an unattractive piece of work at best, calling for special packings which are quite costly and sometimes giving so severe a load of maintainence as to amount in a year's time to as much as the original cost of the pump. A great variety of packings are now available, many built for particular services. Without detracting from the advancement made by packing manufacturers, it should be pointed out that the average chemical service can be handled with a good grade of packing which is relatively resistant to the material handled. In general, blue African asbestos is an excellent material for chemical services. The most important thing to keep in mind about a stuffing box is to remember to treat it as though it were a bearing, which means that it must be kept clean, cool and lubricated.

In applying the unit to service, provision must be made to observe these points. The easiest way to do this is to construct the pump with the conventional lantern ring approximately in the center of the box. This ring then can be connected to a source

of clear bland fluid under a pressure at least 5 lb. greater than the pressure existing in the bottom of the stuffing box. Fig. 1 shows a device which has been found useful for constant indication of sealing liquid flow. Similar devices are available, such as described by F. H. McBerty (*Chem. & Met.*, May 1937, p. 257).

With a suitable sealing liquid arrangement, the liquid will enter the lantern ring and flow both toward the pump casing proper and out of the stuffing box at the gland end. Thus a clear film of liquid will be maintained, preventing entrance of the corrosive liquid handled by the pump. Careful measurements made upon a unit where the shaft was running truly concentric within the stuffing box, have shown that the leakage into the pump through the annular orifice between the pump shaft and the packing amounted to no more than 46 parts per million parts of liquid passing through the pump. This is so small a quantity of sealing liquid that it generally can be disregarded as a contaminant of the liquid being pumped, and water is therefore often the best material for stuffing box sealing. If water is prohibited by the nature of the process or other considerations, greases insoluble in the material being handled are available and may be applied to the lantern ring of the stuffing box by a deadweight loaded grease sealer.

SEALING LIQUID RESULTS

That this method of handling a stuffing box is of extreme value is illustrated by the writer's experience with a pump handling a slurry consisting of 40 percent by volume of paint pigment in water suspension, the water containing about 5 percent sulphuric acid. Upon initial installation, it was found that very frequent repacking was necessary to prevent leakage of the material pumped, with consequent expensive loss of this material at the stuffing box. The pump was installed with about 10 ft. of suction head. The impeller was designed to impose only suction pressure on the bottom on the stuffing box and on the first ring of packing. In spite of the use of many types and styles of packing, a packing schedule of once every eight hours, three times per day, was necessary to prevent loss of the costly pigment.

Since an exact ratio between acid, pigment and water was necessary, the user was reluctant to try a water seal. He was, however, finally prevailed upon to insert a lantern ring in the stuffing box, located midway axially and connected to an outside source of clear, cool water, at 12-15 lb. pressure. Rather than three times a day, the pump is now being repacked once every six months.

Repeated analyses since the change, comparing the material taken from both the suction and discharge lines, have shown no appreciable dilution nor any change or variation in the subsequent process. Other units in the same plant were checked for shaft concentricity and the stuffing boxes similarly treated, resulting in an annual maintenance saving at this point alone of several thousand dollars. This method of stuffing box maintenance has been widely applied to pumps handling acids, slurries, alkalis and other materials in the chemical industry.

For process units requiring high-head pumps, the method described must be modified somewhat. In high-head, large-capacity chemical pumping operations, the matter of pumping efficiency does become important and each percent of increased efficiency may result in the saving of many dollars per year. For such pumps greater attention must be paid to the impeller design to obtain the most efficient moving element for the particular conditions of service. The single-stage, closed-impeller pump lends itself readily to this refinement.

In the case of water service, the single-stage closed-impeller pump is supplied with wearing rings at the back of the impeller to permit maintaining the liquid pressure within this space at suction pressure, thus simplifying packing of the pump. In a process pump, however, especially where it is constructed of high-alloy materials, such rings are not readily replaceable as they gall at the point of fastening to the impeller. Another means of creating a space back of the impeller and adjacent to the bottom of the stuffing box, which can be maintained at suction pressure, must be resorted to. This can be done by omitting the back impeller ring entirely and inserting in the bottom of the stuffing box a bushing having a close running fit on the shaft. Located directly behind this bushing on the side away from the pump proper, a lantern ring is installed which is connected by means of a tapped hole to the suction of the pump. The cross-sectional area of the connection to the suction is made quite large in comparison with the annular area between the bushing and the shaft, and throttling will consequently occur across this latter opening. The arrangement is indicated in Fig. 2. The pressure on the packing ring adjacent to the lantern ring then becomes suction pressure and the remainder of the stuffing box can be handled as already discussed.

Such a bushing and the sleeve covering this portion of the shaft are inexpensively replaceable parts which can readily be removed and replaced in the event of wear, without damaging other parts of the pump. Single-stage units operating up to 600 ft. head have been built in this manner and have produced enviable service records.

INSTALLATION

Pump installations deserve careful planning, since careless installation, making regular maintenance and inspection difficult, can largely nullify the economical design features built into the pump. Plant designers, in laying out process pumping equipment, too often fail to consider the difficulties to be encountered by the person who has to "live with" this equipment in inappropriate and inaccessible locations. Process pumping equipment is generally of low height and one of the major errors made in its location is to mount the base directly on the floor, making inspection and particularly repacking difficult. Work done in such a position is generally hurried and poorly accomplished to the detriment of the maintenance record. Poorly lighted locations also lead to poor work and high maintenance.

The ideal location is accessible, well lighted and clean—about chest-high on the average workman. Thus normal maintenance jobs such as inspection, greasing of bearings, repacking of stuffing boxes and checking of gaskets can be accomplished in an upright position, using both hands and generally resulting in an excellent job.

A large chemical manufacturer, having constructed a plant, decided after several years to duplicate the installation. However, his engineers decided to locate the pumps quite similarly to the above recommendation. Except for pump placement, the new plant exactly duplicated the old. After several years of operation, a comparison of the maintenance records of the pumps in the new plant with those in the old, indicated that the cost was slightly less than half that of the older installation, fully vindicating the user's judgment regarding placement. The increased construction costs were balanced out by the decreased maintenance cost within 1½ years' operation.

Protection Against War Gases

Chem. & Met. INTERPRETATION

Chemical attack may never come to the civilians of this country, but to be totally unprepared would be dangerous. The information herein, gathered from various sources mentioned in the bibliography gives basic information on protective measures. Original sources should be consulted for further details on gas masks.— *Editors.*

IN GENERAL, no decontamination measures are necessary following an attack with non-persistent gas. However, if persistent gas is used, liquid contamination of streets and the exterior of buildings may result and unless special measures are adopted, the chemical will remain a source of danger for a considerable time.

The principal decontaminating agent for mustard gas is bleaching powder. Chlorine reacts with mustard gas to destroy it, but the two must be brought into intimate contact. However, dry bleach should not be placed directly upon liquid mustard because of the evolution of heat and flame. This drives off a high concentration of vapor which may be carried some distance by the wind, endangering people who would otherwise be safe. In using bleach on mustard gas, the bleach is either mixed with water to a paste or with sand or earth.

It is a safe rule to use one part of bleach for each part of inert material for each 10 percent available chlorine; thus with one lb. of 70 percent H.T.H., 7 lb. of earth may be used.

Cold water has little effect on mustard gas but hot water is fairly effective. Mustard gas is heavier than water and will lie at the bottom of pools and puddles, remaining effective for a long time, though the water will retard the escape of vapors.

Water quickly destroys Lewisite. However, a solid residue is left which is dangerous to touch, though it gives off no gas. After treatment with water, an area should be covered with a layer of earth, sand or ashes. Objects which are to be handled should be treated with an alkali.

Earth, sand, ashes or sawdust may be spread over a contaminated area to give temporary protection. The covering should be at least 3 in. thick. This does not destroy the chemical agent but merely forms a seal to prevent escape of toxic vapor. If practicable, the covering should be wetted down with water.

Green solution is prepared by dissolving one pound of bicarbonate of soda in one gallon of commercial hypochlorite solution. This mixture is less efficient for destruction of mustard gas than bleaching powder but it is less corrosive to metals.

Decontamination may be by (1) destroying the agent by the use of other chemicals or by burning; (2) removing the agent by washing it away; (3) covering with a seal, after which it will slowly be destroyed.

Badly contaminated articles which cannot be decontaminated easily should be destroyed by burying in the ground or by burning. Burning should be done in the open or in an incinerator provided with a tall chimney, since the burning process may drive off a high concentration of gas. Land covered with dry grass and underbrush may be decontaminated by being burned over.

Small areas of ground contaminated with mustard gas may be treated by spreading bleaching powder mixed with sand or soil and spading this mixture into the soil. About one lb.

Chemical Properties of Warfare Agents[1]

Agent	Action on Metals	Stability on Storage	Action with Water	Hydrolysis Product
Adamsite	Very slight	Stable in steel containers	Insoluble, hydrolyzed with difficulty	HCl; oxide $[(C_6H_4)_2NHAs]_2O$; toxic if swallowed
Bromacetone	Very corrosive to iron	Unstable in heat or light	None	None
Brombenzyl-cyanide	Very corrosive to iron; lead or enamel lined shells required	Slowly decomposes	Slowly hydrolyzes	HBr and various compounds
Chloraceto-phenone	Tarnishes steel slightly	Stable	None	Not readily hydrolyzed
Chlorine	None if dry; vigorous corrosion if wet	Stable in iron cylinders, if dry	Form HCl, HOCl, and ClO_2	HCl; HOCl; ClO_2
Chlorpicrin	Produces slight tarnish only	Stable for long periods in steel containers	Very slightly soluble	Hydrolyzes with difficulty
Diphenyl-cyanarsine	Vigorous corrosion on iron and steel	Very stable	None	None
Diphosgene	None if dry, corrosion if wet	Stable in dry steel containers	Hydrolyzes slowly	$ClCO_2$; CO_2; HCl
Ethyldichlor-arsine	None	Stable	Hydrolyzes slowly	Ethylarseneous oxide and HCl (poisonous)
HC Mixture	None if dry	Stable	C_2Cl_6 slowly hydrolyzes; ignites	Smoke in air; ($ZnCl_2$) zinc chloride in water
Lewisite	None	Stable in steel containers	Hydrolyzes readily	HCl; oxide; (ClCH) ($CHAsO$)
Methyldichlor-arsine	None	Very stable	Slightly soluble	None
Mustard	None	Stable in steel containers	Slowly hydrolyzes	HCl and $(HOCH_2CH_2)_2S$
Phosgene	None if dry; vigorous corrosion if wet	Stable in dry steel containers	Hydrolyzes rapidly	HCl; CO_2
Titanium tetrachloride	Vigorous corrosion by smoke; none by liquid on steel if dry	Stable in steel containers when dry	Hydrolyzes	Smoke in air; $TiCl_4 8H_2O$; then HCl and $Ti(OH)_4$
White phosphorus	None	Stable out of contact with oxygen	None; stored under water	Smoke in air; phosphoric acid in water

[1]Adapted from "Chemicals in War," A. M. Prentiss, McGraw-Hill Book Co. (1937).

Persistency and Toxicity of Chemical Warfare Agents [1]

Agent Common Name	CWS Symbol —— Form	Tactical,[2] Physiological [2] Classification	Persistency (Summer)	Persistency (Winter)	Lowest Irritant Concentration [4]	Intolerable Concentration [4]	Lethal Concentration [4]
Bromacetone CH_3COCH_2Br	BA Liquid	H L	3 hr. in open; 1 to 2 hr. in woods	2 days in open; 7 days in woods	0.0015	0.010	3.20
Brombenzyl cyanide $C_6H_5CHBrCN$	CA Gas	H L	3 days in open; 7 days in woods	Several weeks	0.00015	10 min. exposure, 0.0008	30 min. exposure, 0.9; 10 min. exposure, 3.5
Chloracetophenone $C_6H_5COCH_2Cl$	CN Gas Solid	H L	Solid for days; burning mixture, 10 min.	Several weeks in solid; burning mixture 10 min.	0.0003	10 min. exposure, 0.0045	30 min. exposure, 0.34; 10 min. exposure, 0.85
Chlorpicrin (vomiting gas) Cl_3CNO_2	PS Gas Liquid	C H L	1 hr. in open; 4 hr. in woods	12 hr. in open; 1 week in woods	0.009	10 min. exposure, 0.050	30 min. exposure, 0.80; 10 min. exposure, 2.00
Chlorine Cl_2	Cl Gas	C LI	5 min. in open; 20 min. in woods	10 min. in open; 1 hr. in woods	0.029	10 min. exposure; 0.10	30 min. exposure, 2.53; 10 min. exposure, 5.60
Phosgene $COCl_2$	CG Gas	C LI	10 min. in open; 30 min. in woods	20 min. in open; 2 hr. in woods	0.005	10 min. exposure, 0.020	30 min. exposure, 0.36; 10 min. exposure, 0.50
Diphosgene $ClCOOCCl_3$	Gas	C LI	15 min. in open; 60 min. in woods	30 min. in open; 3 hr. in woods	0.005	10 min. exposure, 0.40	30 min. exposure, 0.36; 10 min. exposure, 0.50 (U.S.); 0.05 (Germany)
Methyldichlorarsine CH_3AsCl_2	MD Liquid	C LI V	1 hr.	2 to 3 hr.	0.002	1 min. exposure, 0.025	30 min. exposure, 0.125; 10 min. exposure, 0.75
Ethyldichlorarsine $C_2H_5AsCl_2$	ED Liquid Gas	C H LI V	1 to 2 hr. in open; 2 to 6 hr. in woods	2 to 4 hr. in open; 12 hr. in woods	0.001	10 min. exposure, 0.01 (causes sneezing)	30 min. exposure, 0.10; 10 min. exposure, 0.50
Mustard $\beta\beta'$ Dichlorethyl Sulphide $(ClCH_2CH_2)_2S$	HS Liquid Vapor	C V	24 hr. in open; 1 week in woods	Several weeks both in open and in woods	0.001	Eye-casualty concentration—1 hr. exposure, 0.001	30 min. exposure, 0.07; 10 min. exposure, 0.15
Lewisite β Chlorvinyl-dichlorarsine $ClCH:CHAsCl_2$	M-1 Liquid Vapor	C V	24 hr. in open; 1 week in woods	1 week	0.0008	Minimum irritating concentration, 0.0008	30 min. exposure, 0.048; 10 min. exposure, 0.12
Diphenylchlorarsine $(C_6H_5)_2AsCl$	DA Smoke	H St	5 min. by H.E. detonation; 10 min. by candle dissemination	Same as summer	0.0005	10 min. exposure, 0.0012	30 min. exposure, 0.60; 10 min. exposure, 1.50
Diphenylcyanarsine $(C_6H_5)_2AsCN$	CDA Smoke	H St	Same as DA	Same as DA	0.0001	10 min. exposure, 0.00025	10 min. exposure 1.00
Adamsite Diphenylamine-chlorarsine $(C_6H_5)_2NHAsCl$	DM Gas	H St	10 min. in open from candles	10 min. in open from candles	0.00038	3 min. exposure, 0.005	30 min. exposure, 0.65; 10 min. exposure, 3.00
HC Mixture $C_2Cl_6 + Zn + ZnO$	HC Smoke	S	Only while burning	Same as summer	Smoke irritation negligible	Smoke irritation negligible	Smoke harmless
Titanium tetrachloride $TiCl_4$	FM Smoke	S	10 min in open	Same as summer	Smoke irritation negligible	Smoke irritation negligible	Smoke harmless
Sulphur trioxide solution About 55% SO_3 + 45% $HClSO_3$	FS Smoke	S	While container is operating	Same as summer	Smoke irritation negligible	Smoke irritation negligible	Smoke harmless
White phosphorus P_4	WP Solid Smoke	S I	Depends upon size of burning particle; usually 10 min. or less in open	Same as summer	Smoke irritation negligible	Smoke irritation negligible	Smoke harmless
Thermit $(Al + Fe_3O_4)$	Th	I	5 min. when burning	Same as summer	None	None	None
Magnesium Mg	——	I	15–20 min. when burning freely	Same as summer	None	None	Smoke harmless

[1] Adapted from "Chemicals in War," by A. M. Prentiss, McGraw-Hill Book Co."; "Protection Against Gas," issued by Office of Civilian Defense; "Defense Against Chemical Attack," prepared by the Chemical Warfare Service.

[2] H = Harrasant; C = Casualty Agent; S = Screening Agent; I = Incendiary.

[3] L = Lacrimator; LI = Lung Irritant; V = Vesicant; St = Sternutator.

[4] As cu. per 1000 cu. ft., 10 min. exposure for lowest irritant concentration.

Physiological Action and First Aid for Chemical Warfare Agents [1]

Agent	Odor In Air	Odor Detectable [2]	Physiological Action	Protection Required	Method of Neutralizing	First Aid
Bromacetone	Pungent and stifling	0.0005	Vapor, severe lacrimation; liquid, produces blisters; often toxic	Gas mask; absorbent only	Alkali	Wash eyes with boric acid; wash skin with warm sodium carbonate solution
Brombenzyl cyanide	Like sour fruit	Irritates before odor can be detected	Severe lacrimation and nose irritation; headache	Gas masks; absorbents in canister only	Alcoholic sodium hydroxide spray	Wash eyes with boric acid solution; do not bandage
Chloracetophenone	In low concentrations like apple blossoms	0.0002	Eye and skin irritation; temporary	Gas masks; both absorbent and effective filter	Strong hot sodium carbonate solution	Wash eyes with boric acid; wash skin with warm sodium carbonate solution; do not bandage
Chlorpicrin	Sweetish, like flypaper, anise	0.0073	Lacrimates; irritates nose and throat; produces nausea and lung irritation	Gas masks with high-grade absorbents in canisters	Sodium sulphite alcohol solution	Wash eyes with boric acid; keep patient warm; protect throat from infection; do not bandage
Chlorine	Pungent	0.0100	Burns upper respiratory tracts	Gas masks; absorbents in canister only	Alkaline solution	Keep patient quiet and warm and treat for bronchial pneumonia; coffee as stimulant
Phosgene	Like ensilage; fresh-cut hay; green corn	0.0044	Burns lower lung surfaces, causing edema; tears in eyes; doped feeling	Gas masks; absorbents in canister only	Steam hydrolyzes; alkalies and amines react with CG	Keep patient quiet; administer heart stimulants; give oxygen in severe cases; treat like pleurisy; no cigarettes
Diphosgene	Disagreeable, suffocating; ensilage; acrid	0.0088	Burns lower lung surfaces, causing edema; eyes water; coughing	Gas masks; absorbents in canister only	Steam hydrolyzes; alkalies and amines react with CG	Keep patient quiet; administer heart stimulants; give oxygen in severe cases; treat like pleurisy
Methyldichlorarsine		0.0008	Asthma, dyspnea; lung injurant, skin vesicant	Gas masks and best of protective clothing	Sodium hydroxide solution	Wash with soap and water, then with sodium hydroxide (5%); wash eyes with boric acid
Ethyldichlorarsine	Biting, irritant; like pepper in nose	0.0010	Vesicant, ¼ as powerful as HS; powerful sternutator; causes paralysis of fingers	Gas masks and protective clothing	Sodium hydroxide solution; cover with earth, caustic	Wash skin with warm sodium carbonate solution; remove liquid with H_2O_2 or kerosene
Mustard	Like garlic or horse-radish; mustard	0.0013	Dissolves in skin or lung tissue, then produces burns; delayed effect; eye irritation; may lead to pneumonia	Gas masks and protective clothing	Bleaching powder, 3% sodium sulfite in water; steam; gaseous chlorine; or bury under moist earth and unslaked lime	Wash affected parts with kerosene or gasoline, then with strong soap and hot water; rub dry; rinse with hot clean water; agent must be removed within 3 min.
Lewisite	Like geraniums, then biting	0.014	Dissolves in skin, then burns eyes, nasal passages, skin	Gas masks and best of protective clothing	Alcoholic sodium hydroxide spray; wash down with water; cover with earth	Wash with oils, hot water, and soap; dry; first aid must be applied at once; rest
Diphenylchlorarsine	Like shoe polish	0.0003	Sneezing; vomiting; headache	Best type of filter in gas-mask canister	Caustic gaseous chlorine; bleaching powder solution	Chlorine in low concentrations; keep quiet
Diphenylcyanarsine	Like garlic and bitter almonds	0.0003	Sneezing; vomiting; headache	Gas masks, best type of filter	Caustic gaseous chlorine	Chlorine in low concentrations
Adamsite	Odor similar to coal smoke	Almost no odor to average man, up to 0.0025	Headache, nausea, violent sneezing, followed by temporary physical debility	Best type of filter in gas-mask canister	Gaseous chlorine; bleach liquor	Breathe low concentrations of chlorine from bleaching-powder bottle; keep quiet and warm
HC Mixture	Acrid suffocating smoke		None from solid; slightly suffocating action by heavy smoke	None	None needed	None needed
Titanium tetrachloride	Acrid		Liquid burns like strong acid; vapors and smoke irritating to throat	None for ordinary smoke clouds; gas masks needed for heavy concentration only	Alkali; solid or solution	Wash with sodium bicarbonate solution, then with warm water; treat burn with picric acid
Sulphur trioxide solution	Acid or acrid		Liquid burns like strong acid; smoke causes pricking sensation on skin	None for ordinary smoke; gas masks for high concentrations, only rubber gloves for handling liquid	Any alkaline solution	Like an acid burn
White phosphorus	Like matches		Solid particle burns flesh; vapors very poisonous, cause bone decay; smoke relatively harmless	None needed against smoke; fireproof suits against burning particles	None needed; copper sulphate solution stops burning of particles, as does water	Apply copper sulphate solution; pull out solids; treat burn with picric acid; keep burning part under water until medical aid arrives if no $CuSO_4$ is available

[1] Adapted from "Chemicals in War," by A. M. Prentiss, McGraw-Hill Book Co.; "Protection Against Gas," issued by Office of Civilian Defense.
[2] As oz. per 1000 cu. ft.

of bleach is required per square yard of ground. If no bleach is available, the contaminated area should be covered with wet earth.

Lightly contaminated paved streets may be rendered safe by washing down with a heavy stream of water. Bleach paste or sand and bleach mixture should first be used on all heavily contaminated portions.

Walls of buildings should be sprayed or scrubbed with a 50-50 mixture of bleach and water. Wood, concrete and paint absorb mustard and hence a second decontamination may be necessary. After this treatment, the wall should be scrubbed with hot water, soap and washing soda. Floors should be treated with a paste of bleach to a depth of an inch for 6-24 hours. The paste should then be removed and the floor scrubbed.

Metal equipment should be washed with rags saturated with gasoline or kerosene. Bleach solution should then be applied, followed by soap and hot water. Finally, after thorough drying, the surface should be oiled. If the equipment can be seriously damaged by corrosion, the bleach should not be left on the metal for more than a few minutes. In place of these measures, non-corrosive decontamination fluids, if available, may be used.

A person whose clothes have come in contact with mustard vapors should remove them at once and bathe. The clothes should then be aired in the sunlight for at least two days and if they have been contaminated with liquid mustard, they should be steamed for 4-6 hours.

Ordinary dry cleaning will not suffice for treating contaminated clothes. Contaminated shoes should be shuffled in sand and bleach mixture to remove unabsorbed liquids. Once the agent has penetrated the leather, little can be done to make them safe.

Sprayers used in decontamination work may be small hand-operated devices such as garden sprayers or large, power-driven apparatus which can be carried on a truck. For spreading bleach solution on city streets, water sprinklers might be used.

First Aid Chest For Gas Casualties[1]

1. Bleaching powder (high test)..2 lb.
   For decontamination of skin from blister agents; for inhalation following irritant smokes.
2. Protective ointment (3 oz. tube)..10
   For protection of skin and decontamination following blister agents.
3. Hydrogen peroxide (10 percent avail. O_2) .....1 qt.
   For removing lewisite from skin.
4. Kerosene .....6 qt.
   For removing mustard from skin.
5. Alcohol (70 percent).....1 qt.
   Following No. 4 and No. 8.
6. Soap, cakes 6
   To remove No. 3, No. 4, and No. 8.
7. Sodium bicarbonate (baking soda) .....5 lb.
   (A) For eye irrigation following blister gases, tear gas, or other chemical agents; (B) for washing nose, throat, and stomach following blister agents; (C) for drinking after arsine exposure.
8. Lye .....1 lb.
   For lewisite if No. 1 and No. 3 not available.
9. Butyn. N.N.R. 3 gr. hypo. tablets, 10 per vial..... 2
   For preparing solution to relieve pain in eyes from mustard and lewisite.
10. Antipruritic ointment .....3 oz.

	Percent
Benzyl alcohol	50
Stearic acid.....	30
Glycerine	10
Ethyl alcohol.....	8
Pontocaine	1
Menthol	1

    To relieve itching following mustard burns.
11. Four percent soln. sodium sulfite in 50 percent alcohol..8 oz.
    For removing tear gases from skin.
12. Aspirin, 5-grain tablets.....100
    For headache following irritant smokes.
13. Cupric sulphate (blue vitriol)..1 lb.
    For phosphorus burns.
14. Absorbent cotton .....1 lb.
15. Enema can and tube for irrigating eyes 1

[1]From "Protection Against Gas", Office of Civilian Defense, Washington, D. C.

PROTECTIVE MEASURES

Individual protection from chemical warfare agents can be obtained by the use of gas masks and protective clothing. Collective protection, on the other hand, depends upon gas alarms and accessibility of gasproof shelters.

Gasproof shelters are of two general types, non-ventilated and ventilated. The non-ventilated shelter is merely a room, cellar or other inclosure sealed to prevent air from the outside from entering. Such shelters can only be occupied for a limited time. The ventilated shelter is an inclosure rendered reasonably gas-tight and equipped with apparatus to draw in outside air through a canister which removes the harmful gas. Such shelters can be occupied indefinitely.

Details on features and use of gas masks, protective clothing and gasproof shelters are beyond the scope of this article. Authoritative information can be obtained by consulting the references listed in the bibliography.

Since war gases are heavier than air, they tend to hug the ground and accumulate in low-lying places. In open country they will remain effective in ravines and gullies for a considerable time. Likewise, they persist longer in woods than in open areas.

If used against towns and cities, gas may be expected to accumulate in subways, cellars, sewers and other low-lying places. Hence persons on the upper floors of buildings might be entirely safe, whereas those at ground level would be exposed. Even the upper floors of a 2- or 3-story house are considerably safer than a lower floor or cellar. Gas tends to pass around and over a house if doors and windows are closed. However, unless all cracks and crevices are sealed, the gas will eventually penetrate the house.

Low velocity and steadiness of wind are favorable for the use of gas. If the wind velocity is more than 10-12 miles per hour or if the wind is gusty, the gas cloud is quickly dissipated.

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Load-Center Power Distribution

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Chem. & Met. INTERPRETATION

Load-center power distribution as such is not new, having been applied for years in the utility field. However, the development of new equipment has now made it possible to extend its advantages to industrial and commercial buildings where it offers many advantages over former methods. These are savings in time, money and material as well as safer, more reliable service.—*Editors.*

INTENSIVE manufacturing activity accompanying the present war program has stimulated interest in power distribution systems. A review of these systems has resulted in the development of the "Load-Center Power Distribution Principle" for industrial plants and for other applications where the problems are similar.

There are two outstanding fundamental principles of load-center power distribution: (1) power is distributed at high voltage to the load centers where it is stepped down to utilization voltage and distributed to the load via short secondary feeders; (2) when the total load exceeds about 750 to 1,200 kva., several small unit substations are used rather than a single large substation. Each is located near the center of the load area.

The old method consists of a large substation in which large blocks of power are transformed from high voltage to utilization voltage, the utilization voltage being of the order of 110 to 575 v., and the primary voltage ranging from 2.3 to 15 kv. Power is then distributed throughout the factory through long, heavy low-voltage feeders from one large substation.

One of the most outstanding advantages of load-center distribution under present conditions is that it requires less of the strategic materials so vitally needed for military purposes. Because low-voltage feeder runs are short, there is a large saving in copper. There is also some saving in steel and a slight increase in other materials, principally insulation.

Because the low-voltage feeder runs are short, the investment in secondary cable is materially decreased for load-center distribution systems. There is also a saving in substation cost because of the lower interrupting capacity breakers of the small unit substation. Instead of an outdoor switching station as conventionally used, a small compact indoor metal-clad structure is all that is required. This offers some reduction in cost.

Because substations of load-center distribution systems are small, they can be added when and where needed without extensive planning and forecasting. This is compared with the old method which, using large substations, involves extensive forecasting of location and magnitude of loads in order to select the most advantageous location for the large substation.

Furthermore, the small substations lend themselves ideally to being completely built and wired in the factory. It is merely necessary to bolt one or two sections together and connect the cable. This is compared with the older method in which detail drawings must be made for the assembly of the component piecemeal parts. With the factory-assembled equipment, one set of drawings (made by the manufacturer) is required to build standard unit substations. Hence the drafting cost per unit is extremely small.

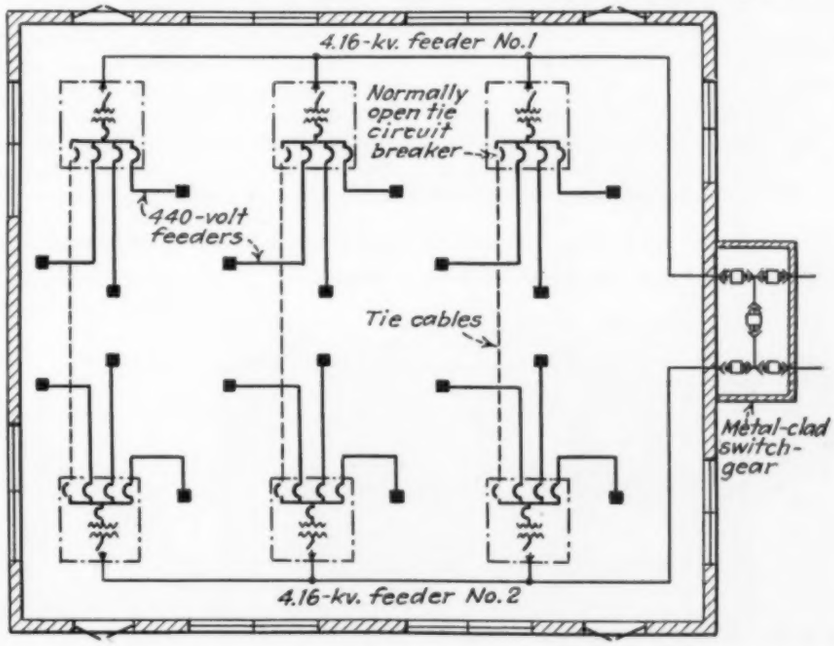
Only a simple functional specification is required for buying unit substations. The older method requires a complete specification for every part. The saving in time and effort in preparing specifications is significant.

Because of the shorter secondary runs accompanying small transformers, voltage drop and flicker are less than with the conventional system.

FORMS OF DISTRIBUTION

Having pointed out the advantages of the load-center distribution center, there remains the need for compar-

Typical load-center distribution system, with power being distributed at high voltage (2.4 to 13.8 kv.) to small unit substations located throughout the plant



ative analysis of system design variations as influenced by considerations of service reliability. In any such analysis, it is important that recognition be given to first cost, safety both to personnel and equipment, operating simplicity, maintenance expense, voltage regulation, power losses, and flexibility.

Simple Radial System—The simple radial system incorporates a single direct electrical channel leading to each load-center low-tension bus. All elements comprising this system are considered to be normally operated at rated capacity. The lowest possible first cost is thus obtained and will be considered as the reference level in cost evaluation of other system forms.

The simplicity of electrical circuit configuration in combination with recognized adequate capacity in all power switching equipment makes for ease of operation and a high order of safety.

The voltage regulation between the primary high-tension bus and the low-tension feeder terminals is in the order of five percent or less, which is not objectionable.

The complete absence of duplication in power-supply channels is the outstanding deficiency.

Primary Selective System—This system is distinguished by the inclusion of load-center primary selector switching in connection with duplicate primary feeders. Means are thus provided for restoring service to all load centers in the absence of voltage on one primary feeder.

An improvement in service reliability, insofar as primary feeders are concerned, is attained at moderate increase in price relative to the simple radial form (in the order of 25 percent).

Under normal conditions the operating simplicity of the radial system is retained. A considerable reduction in safety of operation is incurred by the use of the primary selector disconnecting switch.

The close physical association of both primary feeder circuits at each load-center primary switching unit is a discomforting feature. Trouble at this spot as a result of electrical failure, fire, or bomb explosion could easily involve both circuits and result in a complete loss of service.

Secondary Selective System—Distinguished by a low-tension tie breaker between two complementary sections associated with different primary feeders, this system is normally operated in simple radial manner with the tie breaker open. Duplication of service is extended to the load-center low-tension bus.

Reserve transformer capacity has been incorporated to permit the combined load of the two complementary sections to be carried on one transformer on an emergency basis without exceeding 125 percent of rated capacity. On this basis, the first cost becomes about 145 percent compared to the simple radial form.

Electrical faults affecting service on one primary feeder cannot interfere with service on the other feeder. Even closure of the low-tension tie breaker on a solid fault will not disrupt primary feeder power.

All normal switching is performed with full-capacity, low-tension air circuit breakers.

By incorporating electrical operation of the tie breaker, automatic transfer can be obtained, limiting power interruption to a very short duration, thus closely approaching perfect service reliability.

Secondary Network System—This system is characterized by permanently interconnected load-center units by means of low-tension tie circuits. Emergency power for a particular load center is derived from adjacent stations on either side which are associated with different primary feeders. The system requires only a moderate reserve transformer capacity but involves additional investment in low-tension tie circuits.

The secondary network system allows better transformer utilization when confronted with a shifting load area of higher density although the low-tension tie circuit system must be augmented to accommodate the increased power transformer requirements.

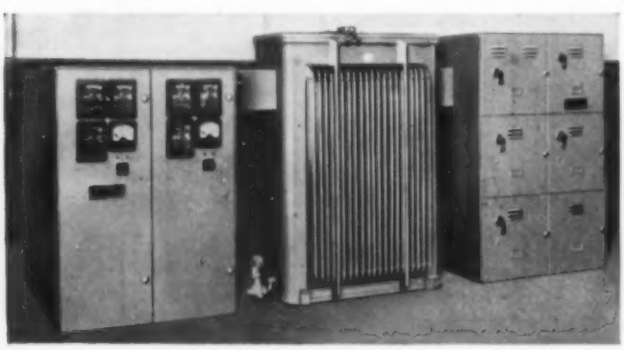
Service reliability is of the highest order, but is associated with a corresponding high order of first cost (approximately 175 percent of the simple radial). The increased cost is largely associated with increased cost of low-tension switching equipment together with the investment in low-tension tie circuits.

Operating simplicity is sacrificed. Any permanently interconnected system presents additional operating problems. The maintenance and adjustment of network protectors and network relays require considerably more skill than do conventional air circuit breakers.

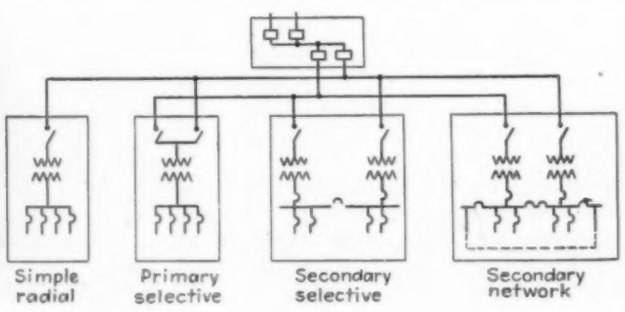
It should be particularly emphasized that one form of system design need not be used exclusively throughout the entire load area if variations in required service reliability seem to favor a combination. On the other hand, it will be advantageous to have a standard system form, to make possible uniformity of operating procedure and a minimum spare parts inventory.

Of these several basic system forms, the secondary selective offers real promise of widespread acceptance in view of: (1) first cost only moderately greater than that of the minimum tolerable system; (2) a high order of safety; (3) simplicity of operation; (4) service duplication extended to the low-tension bus; (5) reduction in degree of service reliability may be exchanged for reduced first cost; (6) increased cost largely invested in active material.

Indoor-type unit substation, 4,160 to 480 volts



Circuit arrangements of load-center power distribution. See text for a comparative analysis of these four basic systems



CHEM & MET REPORT ON

Electronic Devices For Process Control—I

TO CHEMICAL ENGINEERS, SUPERINTENDENTS AND PRODUCTION EXECUTIVES

Now that manpower shortages are definitely making themselves felt, process industries have urgent need for new and better tools with which to increase labor and production efficiency. Many possibilities for such improvement exist in the application of electronic devices to the control of processes. Although not yet well known to the majority of chemical engineers except in a few common industrial applications, electronic tubes and photocells have developed with amazing rapidity, and the scope of their accomplishments is legion. To make clear what some of these accomplishments are, the editors have enlisted the assistance of an authority well known in the field of industrial electronic tube applications. This first of two reports will discuss the types and principles of electronic devices used in control. The second will deal with control applications, and also with a number of important uses outside the field of control proper.

CHEMICAL AND METALLURGICAL ENGINEERING · MARCH, 1942

Electronic Devices For Process Control—I

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Chem. & Met. INTERPRETATION

This is the first of two *Chem. & Met.* Reports on a subject which has received all too little attention from chemical engineers. In the recent past, electronic devices, both electronic tubes and photocells, have been developed to a high state of perfection. As improvement has come about, applications have grown apace, and today these extremely versatile tools have expanded their fields of use far beyond the communications industry, and into a tremendous variety of industrial applications. Although the main aim of this and the report to follow next month will be to deal with electronic devices in relation to their use in process control, other aspects are also of great importance, for example, in the rectification and inversion of electric currents. A part of the second report, therefore, will take up some of these uses. After an introductory part which will discuss the types and principles of electronic devices met in industrial control, the remaining portion of these articles will be devoted to a resume of applications which in scope and variety should prove decidedly suggestive to engineers on the look-out for better and easily adapted methods—*Editors.*

ELECTRONIC DEVICES, in the space of a few years, have taken a place of tremendous importance in industry, although as yet their vast possibilities have barely been assayed. They are the basis of a large part of the communications field and yet their applications are by no means limited to communications. Indeed, it may eventually be true that industrial usage will overshadow that in radio, television, telephony and sound reproduction. For electronic devices are able to do many things better, faster, more accurately, cheaper, and with less wear and tear than their mechanical counterparts. They can control all manner of mechanisms from a beam of light, or from a minute movement or a change in a physical or chemical property of material. They measure numerous variables with high accuracy and can convert electric currents of one type to another with ease and facility.

Although it is often remarked that nobody knows what an electron is, still, this has offered little hindrance to extension of applications for electronic devices which now are numbered well in the thousands. Many of these uses are directly in the field of the process industries and chemical engineers to an ever increasing extent are coming in contact with controls and other equipment employing these versatile devices. Rapid as has been the expansion of the field, still the growth of its literature has all but kept pace. Excellent books have been written on industrial applications alone, so it is obvious that the present writer, in the space at his disposal, cannot hope to do more than scratch the surface, set down a few principles and describe a few applications particularly pertinent to the process industry group.

In attempting a general theoretical discussion of electronics the starting point is necessarily a brief review of the atomic theory. This theory states that the ultimate particles of matter are atoms each of which consists of a central nucleus or mass of positively charged particles termed a proton, around which negatively charged particles called electrons move in intricate orbits. The positive charge of the proton nucleus exactly equals the combined negative charges of the electrons which revolve about it so that the atom in its normal state is neutral, that is, without an electrical charge.

It is possible, however, for an atom to lose one or more of its electrons and thus to carry a reduced negative charge. The effect is to leave the atom positively charged, in which condition it is termed an ion.

An electric current is produced by any condition which results in the flow of electrons from one point in a circuit to another. In the usual sense, electrical flow takes place through a material termed a conductor. In the science of electronics (applied to devices using electron tubes), the flow of electrons takes place through a more or less completely evacuated space, and is a primary function of the apparatus.

The term, electronics, is generally used to denote the study of activity and control of electrons. In view of the limitations placed upon the present article, the term is here used more specifically to apply to the study and application of devices in which electron tubes, such as photoelectric cells and amplifiers, are used.

A few more definitions are also in order. An electron tube, also known as a thermionic valve, radio tube and by various other names, is a mechanism for the control or translation of energy (usually electrical), which consists of an evacuated or partly evacuated inclosure, with two or more electrodes.

A photoelectric cell, also referred to as a photocell, phototube or light valve, is one class of electron tube in which a flow of electrons between two or more electrodes in an inclosure is brought about by the action of light or other radiation on one of the electrodes. The flow of electrons in the external circuit of the photoelectric cell is capable of controlling some other mechanism such as another electron tube, or a sensitive electro-magnetic relay.

The science of electronics has come to cover a great many electronic devices. In general, however, these devices fall into two classes which are frequently interdependent on each other for the solution of a given problem. Thermionic tubes proper form the first class while photoelectric mechanisms which control the flow of electrons by means of illumination form the second class.

Historically, the photoelectric cell considerably antedates the thermionic tube. It was the latter, however, which developed first and without which the photoelectric cell would certainly never have reached its present useful state. On that account the first part of this discussion will deal with the thermionic tube, the second part with the photoelectric cell. A continuation of this paper (to appear in our April number—*Editor*) will deal briefly with a few of the more specialized types of electronic devices used for process industry applications other than in control, and also with the applications of both thermionic tubes and photoelectric cells in process control.

ELECTRON TUBES

Although properly the term electron tube should also include the photoelectric cell, present day usage restricts this designation largely to electron tubes of non-light-sensitive types. For the remainder of this discussion, therefore, this distinction will be accepted.

An electron tube is a device consisting of an envelope or inclosure, generally of glass or metal, evacuated to any desired extent and containing a gas or vapor at a pre-chosen pressure. In the envelope are two or more electrodes. Between these electrodes a flow of electrons can be induced under suitable circumstances.

Electron tubes are divided into two main classes, the first or high-vacuum type, including all tubes in which the electron current flow takes place in a highly evacuated space, while the second or gas-filled type includes those in which the current flow occurs in an inclosure containing a gas or vapor at a pressure considerably higher than in tubes of the first class. Both types are fundamentally similar in that each has an element which serves as a source of electrons and a second element which acts as the receiver of the electrons. A tube of either class may have one or more additional elements serving as control electrodes to regulate the flow of the electron current. It is clear, then, that the principal difference between these two types of tube is the pressure of gas or vapor in the space between the electrodes. In the high-vacuum tube the pressure is reduced to about 10^{-3} microns while in the so-called gas-filled tube, the tube is first evacuated and then the desired gas or vapor is admitted to a pressure ranging from 1 to 500 microns, depending on the requirements for the particular tube.

In the standard terminology of electronics, the tube element which serves as the source of electrons is called the cathode, while the element to which the electrons flow is called the anode (or plate). Other electrodes which may be used in the tube are referred to as control electrodes (or sometimes as grids).

The present day electron tube is a direct result of the discovery during the latter part of the last century that it was possible to produce a flow of electric current through an evacuated inclosure between an incandescent filament and a positively charged plate. Since Thomas A. Edison was one of the first to notice this effect, it has since been called the Edison effect. In 1883, during his experiments with the incandescent lamp, Edison found that when he mounted a small metal plate in the lamp and connected the plate through a meter to the positive terminal of a direct current source, the meter would indicate a small flow of current (Fig. 1). Conversely, with the negative terminal connected to the plate, no current would flow. Edison himself was primarily interested in the production of light by means of electricity and apparently made no attempt to explain this effect. It was not until six years later that Ambrose Fleming in England appreciated the significance of the phenomenon and recognized that such a device could be employed as a rectifier. Eventually he used a tube of this character as a wireless signal detector.

While a two-electrode tube of this sort did have important possibilities as a rectifier (which possibilities were not at that time fully recognized) the step which was to make the electron tube the versatile servant it now is, was still to be taken. It was not until 1906-7 that the simple idea of applying a third intermediate electrode for control purposes was applied by Lee De Forest (Fig. 2). This third element, which he termed a grid, immediately opened up the entire field of electronics to the extremely diverse stage of development which it has reached today. Electronic tubes now operate in many capacities which may be roughly classified as:

1. Amplifiers and de-amplifiers
2. Oscillators or generators
3. Rectifiers for both high and low frequency
4. Relay tubes
5. Inverters, for changing direct to alternating current
6. A variety of tubes for measuring physical units such as voltage, current and numerous other miscellaneous applications

It has already been mentioned that present-day electronic tubes, particularly when they are used for control purposes, may be classified as high-vacuum and gas-filled types. In these two types, the main applications are as follows:

High-Vacuum tubes

1. Rectifiers
2. Amplifiers
3. Oscillators or generators
4. Measuring devices
5. Relays

Gas-Filled Tubes

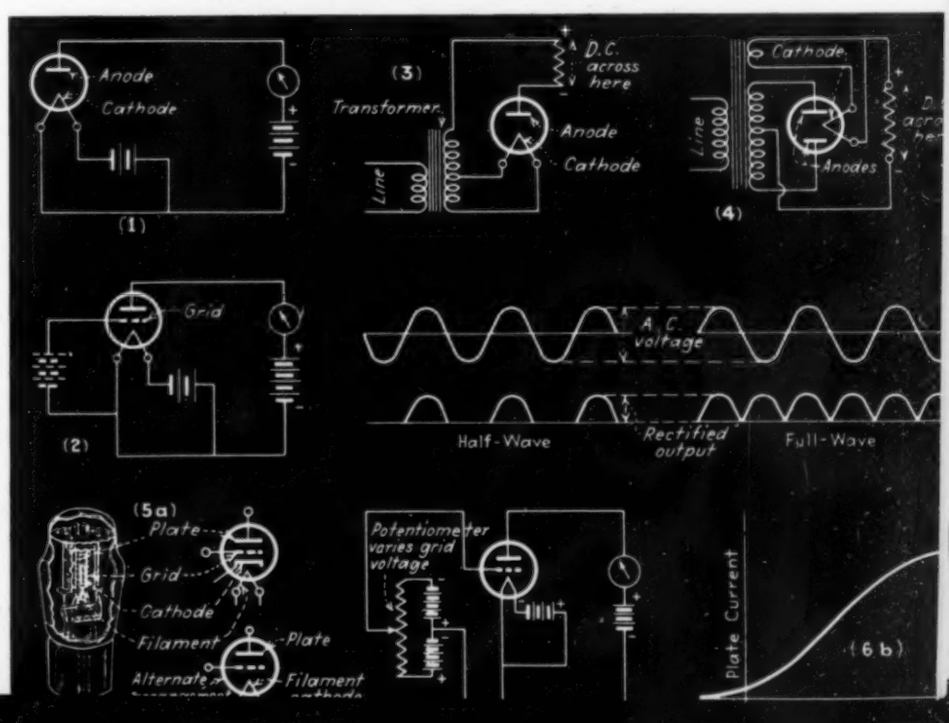
1. Rectifiers
2. Inverters
3. Relays

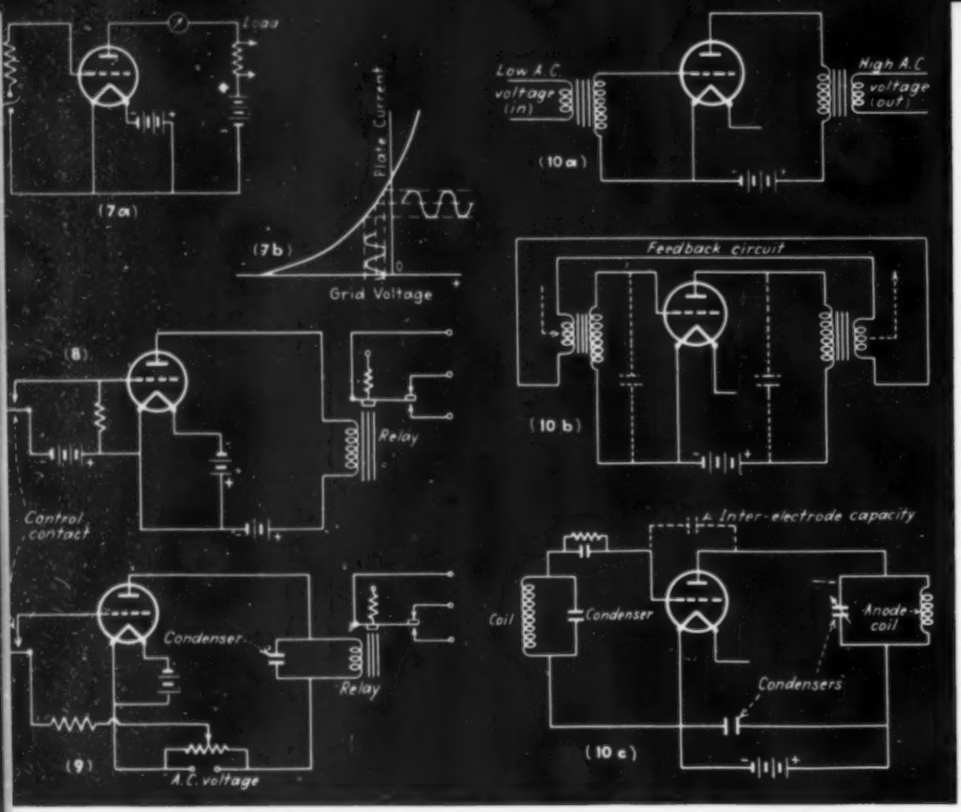
Electronic tubes of these two classes are sometimes used in combination and in some cases may be applied interchangeably. The present article is concerned primarily with the high-vacuum type, which is the one chiefly used for industrial control, and with the gas-filled type employed as a relay tube. The second article will touch briefly on other applications of the gas-filled tube of interest to chemical engineers.

HIGH-VACUUM TUBES

Rectifiers—The rectifier consists of two electrodes in an evacuated inclosure and is the simplest form of high-vacuum electronic tube. Its operation, as has already been noted, is based upon the Edison effect. In common with all other electronic tubes, one of its electrodes which is designated as the cathode serves as a source of electrons, while the other, known as the anode, functions as an electrode collector. The cathode usually consists of a heated wire filament which is sometimes coated with a rare-earth oxide capable of giving up electrons at a lower temperature than the heated wire itself. The second electrode, or anode, is a metal plate situated close to the cathode. As in Fig. 3, when an alternating voltage is impressed upon the anode and cathode in series with a load, current flows between them and through the load only

(1) Edison-effect circuit; (2) DeForest's apparatus, adding control grid; (3) Half-wave rectifier circuit; (4) Full-wave rectifier; (5a) Modern triode tube; (5b) Alternate form with filament cathode; (6a) Circuit for determining tube characteristics; (6b) Typical electronic tube characteristic curve





(7a) Typical amplifier circuit; (7b) Effect on plate current of varying grid voltage; (8) High-vacuum electronic tube relay; (9) Gaseous electronic tube relay; (10) Steps in evolution of vacuum tube generator; (a) A.c. amplifier; (b) Back-coupled amplifier; (c) High-frequency oscillator circuit

during those portions of the cycle when the anode is positive.

The mechanism of this action is clear when one considers the nature of the electron and the electron-emitting cathode. The release of electrons from the surface of the heated filament (which in an electron tube is heated electrically, although it might be heated by any other means), may be likened to the escape of atoms from the surface of a liquid as its temperature is raised. According to the kinetic theory, as the temperature of the filament is raised, the activity of the atoms increases and more and more electrons leave their orbits, flying into the space surrounding the filament. The the normal course of events an equilibrium is quickly reached with as many electrons returning to the atoms as leave in a given time.

However, when it is recalled that electrons are negative charges and hence capable of attraction by a positive charge, it will be evident that the equilibrium can be upset by introducting a positively charged object in the vicinity of the electron-emitting filament. In Edison's experiment, when he maintained his anode plate at a positive potential, a small current of electrons flowed continuously from the heated filament to the anode and thence through the meter in his external circuit. In the rectifier, however, with an alternating potential applied to the anode as shown in Fig. 3, only during the portion of the alternating current cycle when the anode is positive can electrons flow from the cathode to the anode. During portions of the cycle when the anode is negative, the electron flow is suppressed and the electron equilibrium at the cathode is restored.

Thus with a rectifier tube interposed in the load circuit, one-half of the alternating current wave is stopped in the load circuit, with the result that a pulsating direct current flows. Rectification of this type is called half-wave rectification and can be used in cases where a pulsating direct current is not a disadvantage. Where full-wave rectification is desired, two half-wave rectifiers may be employed, so connected as to allow each rectifier to work alternately and thus deliver a rectified output in which both halves of the alternating current wave are turned in the same direction to deliver a smoother direct current output to the load. As shown in Fig. 4, it is usual to construct the two half-wave rectifiers in a single evacuated envelope, employing a common cathode. Half of the transformer secondary is used to apply potential to one anode plate, the other half to the other anode. A separate secondary winding is used to provide the heating current for the cathode filament.

Amplifiers—Although it was several years before De Forest's three-element tube became a full fledged amplifier, the amplifying type of electronic tube definitely stems from his idea. In the construction of the three-electrode tube (Fig. 5), the control electrode or grid is placed closer to the cathode than is the anode. The effect of this is that a smaller voltage is required on the grid to influence the electron stream between the cathode and the anode than would be required at the anode. Thus the grid acts as a valve which, with the application of relatively little energy, can control the flow of a comparatively large amount of energy (Fig. 6). A small positive voltage impressed on the grid will greatly increase the flow of electrons to the anode, while a small negative voltage will greatly decrease the flow. The ratio of voltage change in the control grid circuit, to the corresponding voltage change produced in the anode circuit, due to the change of anode current through the load, is called the amplification coefficient of the tube. These relations may be seen more clearly by reference to the circuit and diagram of Fig. 7.

Amplifier tubes may be designed to operate for the amplification of (1) direct current; (2) low-frequency alternating current; (3) high-frequency alternating current. The same basic electron tube is used for each type of service. If greater overall amplification is desired than is obtainable with a single amplifier tube, it is possible to couple amplifiers in cascade fashion, so that the output of the first amplifier is fed to the second as input, and so on. Depending on how the amplifier is to be used, a variety of methods of feeding one amplifier from the output of the preceding amplifier may be used.

Amplifier tubes, so far as they are used for industrial control purposes, are generally applied as relays in cases where it is desired to operate a rugged electro-magnetic relay by an extremely weak control current. A common example is in cases where the primary detection means is a photoelectric cell, the current output of which is necessarily small. Although sufficiently sensitive electro-magnetic relays can be employed on certain photoelectric applications, particularly with strong illumination, such relays are generally impractical owing to their extreme delicacy. Use of an electronic amplifier permits a rugged relay to be used and so results in a much more reliable installation. Examples of the use of amplifier tubes for the operation of electro-magnetic relays appear in Figs. 8 and 9.

This combination of amplifier tube and electromagnetic relay is an extremely common one in industrial control, for a very small change in the grid voltage of the amplifier tube can be made to control a large amount of current at the magnetic relay. A common arrangement is to apply a fixed negative bias (potential) to the grid of the tube so that when the grid circuit is closed through the control contact, no grid current will flow and hence the control contacts will not be required to carry current. Without such a negative bias, the grid, when it is made positive with respect to the cathode, acts as an anode, thus permitting a grid current to flow. Fig. 8 shows a circuit of this type in which the anode current through a magnetic relay is suppressed when the grid is negatively biased by closing of the control contact. This type of relay mechanism is the sort commonly used as an amplifier relay for photoelectric cells.

GAS-FILLED TUBES

In discussing the high vacuum electronic tube it was brought out that as the grid voltage is changed, the anode current varies. This variation is gradual and the rate of change is dependent upon the rate of change of the grid voltage. However, when the three electrode tube contains a gas, the operation is quite different.

A gas-filled tube is first evacuated and then filled to some predetermined pressure such as 100 microns with a gas such as argon, or with a vapor such as mercury. When an electron current flows between the cathode and anode, in a tube in which gas molecules are present, the effect of these molecules is to increase the electron current by a process known as gas amplification. This process takes place substantially as follows: When electrons are liberated from the cathode and move toward the anode, they will, if they collide with gas molecules and have previously acquired sufficient kinetic energy in their travel, ionize these molecules by knocking off one or more electrons from the molecules. The new electrons thus produced join the stream of electrons from the cathode and flow to the anode, thus increasing the external current. The ionized molecules of gas are drawn toward the cathode where they pick up their missing electrons and become neutralized, ready to pass back into the space between cathode and anode, to await further collisions.

This action within the tube can best be understood by ignoring the control electrode for the moment. As the anode voltage is raised, an increasing number of electrons is drawn to the anode. The greater number of electrons flowing to the anode increases the possibilities for collisions between electrons and gas molecules and as the anode voltage is increased, a point is reached when the current through the gas space between the cathode and anode will increase rapidly to some ultimate value without any further increase in the anode voltage. Under these conditions, as long as the anode remains positive, the current flow will maintain the ionization of the gas indefinitely and will produce a visible glow discharge.

The point where the sudden increase in the electron current takes place is called the break-down point of the tube. After break-down, the current is limited only by the resistance of the external circuit and the situation is similar to that in a mercury vapor or fluorescent lamp. However, when the tube is provided with a control grid, the grid can prevent ionization entirely if it is made completely negative with respect to the cathode. Under these conditions no electrons can pass from the cathode to the anode. If the control electrode is then slowly made more positive in potential, a point will be reached at which ionization of the gas will occur, but at a considerably lower voltage than if applied to the anode.

The grid potential at which ionization occurs is termed the striking potential, and application of the striking potential upon the grid acts as a control trigger, giving a sudden large surge of anode current. Once the striking potential has been reached, making the grid potential negative again will not stop the anode current flow, since it is now maintained by ionization of the gas. The glow discharge may be stopped and the anode current reduced to zero only by opening the anode circuit.

The action of opening the anode circuit can be taken care of automatically in commercial devices by energizing the tube with alternating current. In a tube so energized the anode current can flow only during the positive portions of the anode alternating current cycle, and the discharge will be extinguished every half cycle. A gas-filled three-electrode tube has the advantage of permitting considerably higher anode current than a similar high vacuum tube and this current can be abruptly released by the trigger action of the tube to operate a rugged electro-magnetic relay. A typical circuit for such a tube is shown in Fig. 9.

OSCILLATOR TUBES

The electronic oscillator tube, or alternating current generating tube, is essentially an amplifier in which the output energy is fed back into the input side of the amplifier. This is accomplished so that the feed-back is in proper phase to augment the momentary grid voltage changes. The oscillator circuit can be considered as an electrical analog of the balance wheel and hair spring assembly in a watch. Consider for a moment how this assembly stores energy. The balance wheel is first given an impulse in one direction and moves in that direction until the impulse energy has been stored by the spring. The wheel then reverses its direction of rotation until the spring is wound up in the opposite direction. The balance wheel can be made to continue oscillating with a fixed period if sufficient energy to offset the losses dissipated in work is imparted to the wheel at every oscillation.

An electronic tube oscillator also provides means for storing energy and the characteristics of the energy-storing circuit determine the frequency of oscillation of the current in the circuit. The circuit provides a means for storing energy in either the grid or anode circuit, or both. The storing means usually consists of a coil and a condenser in parallel. When a current is induced in the coil, the potential across the coil will charge the condenser in one direction. The condenser will then discharge through the coil and recharge itself in the opposite direction. In this way an oscillating current is set up in the coil and condenser combination, which dies out gradually as the energy of the system is dissipated. Such a system as this is known as a resonant circuit. Like the balance wheel it can be kept in operation provided a timed impulse of energy is given to the system. Such a system, compared with an amplifier circuit from which it evolved, is shown in Figs. 10*a* and *b*.

With a tube oscillator circuit, the oscillation frequency depends on the capacity of the condenser and the inductance of the coil. The tube has the function of applying the needed impulse to the resonant circuit at the proper time to maintain oscillation, just as the mechanical impulse maintained oscillation of the balance wheel. Fig. 10*b* shows a back-coupled amplifier circuit. Consider that an electrical impulse causing a change in the grid voltage takes place. The tube amplifies this change and causes a large change in anode current. The effect of this change is to charge the anode condenser in one direction, whereupon the condenser attempts to discharge through the anode inductance. However, owing to the connection through the feed-back circuit, the condenser discharge causes a new voltage to appear in the grid circuit in proper phase relationship to the original grid voltage change. The direction of grid voltage change is such as to cause a second anode current change and the recharging of the anode condenser. Therefore the entire operating cycle is repeated, the tube acting as an alternating current generator with a frequency of alternation depending on the values of inductance and capacity.

A part of the energy produced in the oscillator circuit may be removed and utilized for other purposes in a variety of ways. A common method is to let the oscillating current flow through a resistor in the anode circuit, across which an alternating voltage may be taken off. Oscillators may be designed for either high or low frequency.

An interesting feature of an oscillating circuit is that, as the energy of oscillation increases, the anode current decreases. A properly designed oscillator draws a minimum amount of anode energy from the anode battery. Generally the strength of oscillation may be increased by increasing the coupling between the anode and grid circuits. But this decreases the anode current. Hence, by controlling the energy of oscillation (i.e., by controlling the feed-back energy), the anode current can be controlled sufficiently to operate an electromagnetic relay in the anode circuit. This method is being employed in industrial control.

The circuit of Fig. 10*c* shows the arrangement of a typical high frequency oscillator. In this the coupling or feed-back circuit is completed through the inter-electrode capacity of the tube. A resistor is employed in the grid circuit to prevent the grid from becoming too highly positive. The grid becomes more positive for some portion of the oscillating cycle when the strength of oscillation increases. As this occurs the grid attracts electrons from the cathode and a small grid current flows. However, as this grid current flows through the

grid resistor, it decreases the positive bias (increases the negative bias) of the grid, owing to the voltage drop across the resistor. Hence, with the grid biased more negatively, the anode current is reduced.

On the other hand, if the strength of oscillation diminishes, either as a result of drawing energy from the oscillator or because the ability of the feed-back circuit to transfer energy from the anode circuit to the grid circuit is changed, the grid current is reduced. This in turn causes the grid to become less negative (more positive), thus increasing the anode current. From this it is clear that by varying the feed-back energy in the oscillator, the anode current which the tube draws from the anode battery can be varied. A variety of important uses is made of this phenomenon in industrial apparatus.

PHOTOELECTRIC CELLS

As has already been noted, the photoelectric cell was invented long before the thermionic tube but the discovery received little attention and was put to almost no practical use prior to the development of the three-electrode relay type electronic tube. Four general classes of photoelectric cells are known today. While each group contains a number of variations, these variations all depend on the same general operating principles. Photoelectric cells may be classified as follows:

1. Photo Voltaic Cells
   - Becquerel cell (semi-conductor, electrolytic)
   - Photolytic cell (electrolytic CuO)
   - Electrolytic cell (solid electrolyte)
   - Crystal cell (cuprous oxide)
2. Photo-Conductive Cells
   - Selenium bar
   - Selenium bridge
3. Semi-Conductor (barrier layer) Cells
   - Adams and Day cell (1876)
   - Fritts cell (1884)
   - Grondahl and Geiger cell (1927)
   - Present-day cells (Lange, 1930)
   - Cuprous oxide and copper (Westinghouse Photex)
   - Selenium and iron (G.E., and Weston Photronic)
4. Photo-Emissive Cells
   - High-vacuum cells
   - Gaseous cells
5. Special Types
   - Grid-controlled emissive cells
   - Electron multipliers
   - Knowles Photoglow tube

PHOTO VOLTAIC CELLS

As a rough approximation, it may be stated that photoelectric cells either generate an electric current under the influence of illumination, or change their resistance so as to vary a flow of current from an external source when subjected to the influence of light. The earliest cell to be developed was of the former type. Photo voltaic cells generate electrical energy upon being illuminated and generally consist of two electrodes immersed in a solution.

In 1839 Becquerel discovered that two metal electrodes immersed in an electrolyte of their salts would show a difference of potential upon illumination of one of the electrodes. Although the process was not understood at that time, 1839 may still be considered as the date marking the first electrolytic photo element. The Becquerel cell is illustrated in Fig. 11.

It was many years before electrolytic cells of this type found considerable commercial use. Two such cells have been developed in recent years. One type consists of an oxidized copper plate suspended in an electrolyte of lead nitrate. The anode is of lead. A somewhat different and better cell, developed in America, is called the photolytic cell (Fig. 12) and differs from the type just described in that the lead anode is replaced by a second cuprous oxide electrode. The effect is to keep the potential of the cell when it is not illuminated (dark potential) at a low level.

This type of cell suffered from a number of drawbacks, one of the most serious of which was the tendency of the electrolyte to become cloudy owing to the precipitation of salts. An improvement resulted from the use of a solid electrolyte gel made with gelatin or agar agar. Another type of cell using a solid electrolyte employs for this purpose a rock salt crystal which is moistened before sealing (Fig. 13).

All of the aforementioned electrolytic cells operate similarly. When two metal electrodes are immersed in a solution of the salts of the electrode material, an equal and opposite potential is set up between the electrodes and the solution. When one of the electrodes is illuminated, electrons are released from this electrode into the electrolyte so that a potential difference between the electrodes results.

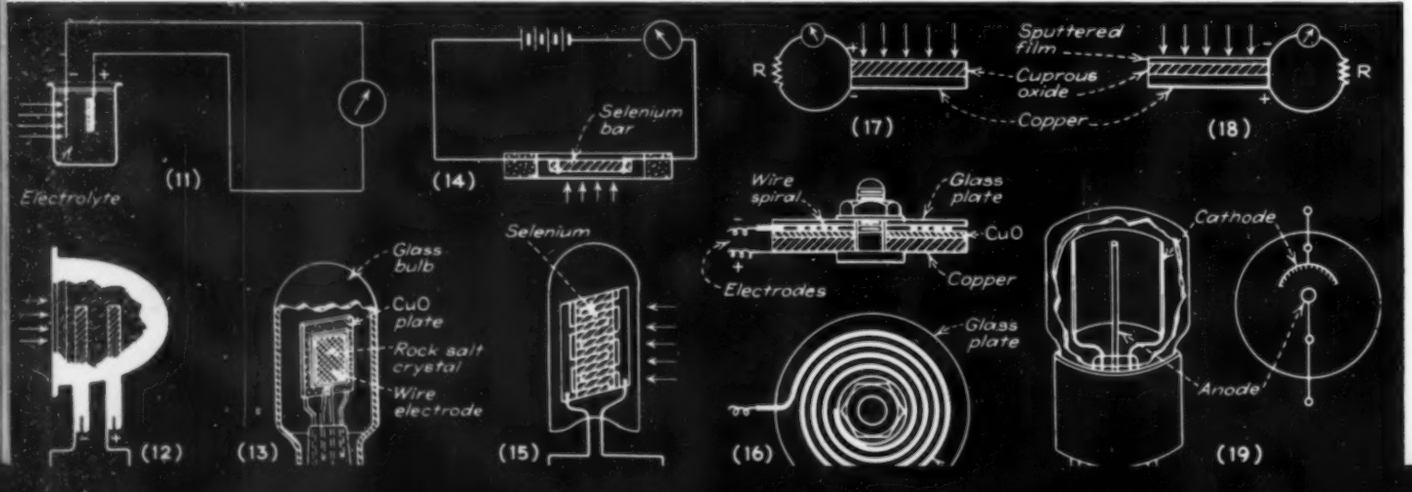
The mechanism whereby illumination liberates electrons from a material under the influence of light is not dissimilar to the liberation discussed in an earlier part of this article in the case of a heated filament. As the number of electrons released depends upon the amount of heat energy imparted to the filament, so the number released in a photoelectric cell also depends on the amount of energy in the form of light falling on the electrode.

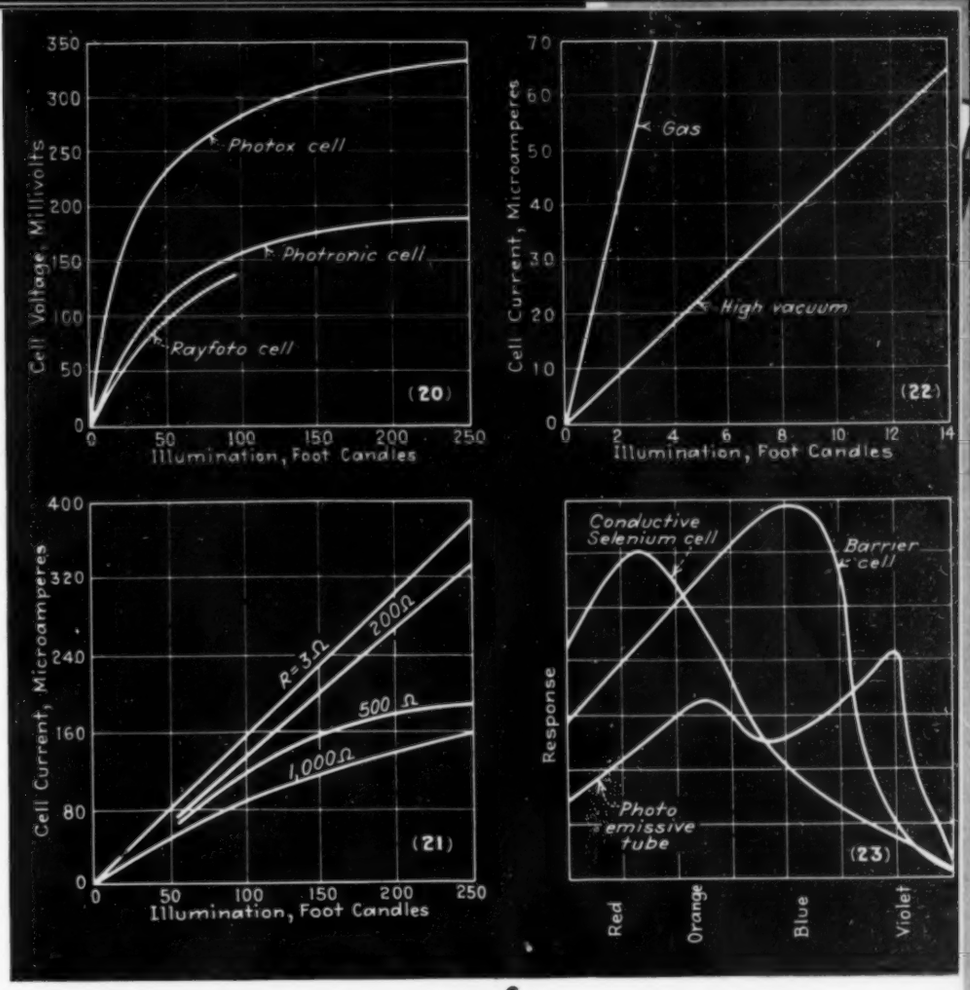
Photo voltaic cells have occasional industrial uses because, with sufficiently intense illumination, they can be made to operate fairly rugged relays. On the other hand, their use is becoming less important owing to their sluggishness.

PHOTO-CONDUCTIVE CELLS

Where the photo voltaic cell is actually a generator of electric current, the photo-conductive cell is a partial conductor which, upon illumination, changes its resistance. The first intelligent observation of the phenomenon of change in electrical resistance of a body with intensity of illumination was made by Willoughby Smith in 1873. Smith was employing tiny rods of selenium metal as a high resistance element in an experimental circuit set up at a transatlantic cable station. He found that these rods became much better conductors of electricity when they were exposed to daylight or to any artificial illumination. Selenium, discovered by Berzelius in 1817, under dark conditions is a very poor conductor but its conductivity improves considerably when it is illuminated. An early experimental cell employing selenium, developed by Adams and Day in 1876, is shown in Fig. 14.

(11) Becquerel photo-sensitive cell of 1839; (12) Electrolytic cuprous oxide cell; (13) Electrolytic cell with solid electrolyte; (14) Adams and Day selenium cell; (15) Selenium photo-conductive cell; (16) Grondahl and Geiger cuprous oxide rectifier disk; (17) Back-effect barrier layer cell; (18) Front-effect barrier layer cell; (19) Modern photo-emissive cell





(20) Voltage produced by barrier layer cells; (21) Current output of Photronic cell; (22) Current output of photo-emissive cells; (23) Response of photocells of various types to light of various colors (wave lengths)

Just how light affects the resistance of selenium is not definitely known but the probable mechanism may be explained as follows. The light is assumed to liberate electrons within the selenium which, as they travel through the substance, may strike positive ions and reunite with them to produce neutral atoms. Since, for any level of illumination, an equilibrium must shortly be reached between the rate of release of the electrons and the rate of recombination, then a maximum value of conductivity for that level of illumination will be reached. When the light is removed, recombination of the electrons and ions will first take place rapidly, thus reducing the number of free electrons and raising resistance, but as the number decreases, so does the probability of recombination and a second equilibrium will be attained at lower conductivity.

As would be expected from the description of the supposed mechanism of conductivity variation in selenium, the release and recombination of free electrons in the material is quite sluggish and the change in conductivity is incapable of following rapid changes in the incident light.

Since the early work with selenium, many investigators have attempted to improve this type of cell, but the limitations of the method have prevented any great success. Perhaps the best of these cells is the Thirring type which decreases the sluggishness to a considerable extent and has a rather high ratio of light to dark resistance. This cell consists of a sputtered film of selenium between two electrodes in an evacuated bulb. It appears in Fig. 15. This cell is rarely used today.

SEMI-CONDUCTOR CELLS

Like the photo voltaic type, the semiconductor or barrier layer cell also generates electrical energy upon being illuminated and may be considered as a form of Becquerel cell having a solid, dry electrolyte. Interestingly enough, the development of these cells hinges on work which was carried out on selenium cells by Adams and Day. In 1876 these investigators found that the illumination of a selenium rod produced a spontaneous potential, independent of the resistance change in the material. They found that on exposing the rod to light a reversal in the galvanometer throw indicated a reversal of the current. This they explained as an additional potential produced within the rod by the incident light.

In 1884 an improved selenium cell was designed which was remarkably like cells manufactured today. Charles Fritts, in New York, built a type consisting of a metallic supporting plate, covered with a thin layer of selenium, upon which light fell through a thin sheet of gold leaf. This cell also produced a spontaneous potential upon illumination. Fritts' cell offered an improved arrangement in construction, making possible longitudinal illumination, but it suffered from the disadvantage of high contact resistance and reduced photoelectric current owing to the loosely attached gold electrode.

These objections probably account for the fact that commercial use of cells of this type was not attained until 1927. In that year Grondahl and Geiger were searching for a satisfactory dry-disk rectifier material. In working with their cuprous oxide rectifier they discovered a change in resistance when the edge portion was illuminated. This cell, shown in Fig. 16, still did not have the sheet-like translucent front electrode upon which modern cells depend for their higher efficiency. However, with the publication of their findings, many investigators took up the work, among them Lange, Everrett, Bergmann, Falkenthal, Rothe, Bohucke and others. The result of this increased interest in the solid-electrode dry-type photo voltaic cell was the modern barrier layer cell now used to such a large extent in colorimetric equipment and illumination and exposure meters.

MODERN BARRIER CELLS

The modern barrier layer cell is made in two distinct types, one known as the back-wall or back-effect cell (Fig. 17), the second known as the front-wall or front-effect cell (Fig. 18). The first type employs a thin layer of cuprous oxide formed upon a copper surface. A ring of gold or platinum is sputtered or deposited upon the outer edge of the cuprous oxide to serve as a contacting means. Impingement of light upon the cuprous oxide film causes electrons to flow across the boundary between the oxide and the copper. Owing to the fact that the action of the light takes place at the boundary surface between the oxide and the metal, the light must pass through the layer of oxide. In this cell the boundary is the seat of the barrier effect. Since the electrons flow from the oxide to the copper, the copper becomes negative with respect to the oxide. When an external circuit is completed between the copper and the oxide, an external current flow is produced, the electrons flowing in that direction.

As has been noted, this cell is referred to as the back-effect cell because the emission of electrons takes place at the back of the oxide film, requiring the light to pass through the film. A better type of cell, the front-effect type of Fig. 18, is made by sputtering a thin translucent film of silver, gold or platinum on the exposed surface of the cuprous oxide layer which has previously been formed on copper as in the back-effect film. Light entering the cell passes through the sputtered film, with the emission of electrons taking place at both surfaces of the oxide. This emission is, however, greater at the front surface, causing the sputtered film to become negatively charged with respect to the copper and producing a current flow through an external circuit from

the sputtered film, through the circuit, to the copper backing. In this cell, as distinguished from the back-effect type, the light is only very slightly absorbed in passing through the sputtered film.

Other materials than copper and cuprous oxide may be used in the manufacture of barrier layer cells. One commercial form, for example, employs iron selenide and iron.

Cells of the photo voltaic and barrier layer types have the important advantage that they require no external voltage supply and are themselves generators of electricity. One reason for the interest they have attracted lies in the fact that they offer a means for the direct conversion of solar energy into electrical energy. Such cells have actually been used to drive tiny electric motors direct from sunlight. With them it is possible to obtain an output of about 1 watt per square yard of sensitive surface, but at the present stage of development such cells would be a decidedly inefficient method of converting solar energy which as an average reaches the earth at the rate of about 2,000 watts per square meter. The output is, however, sufficient to operate sensitive relays when enough illumination is available. Current and voltage characteristics of a number of different makes of barrier layer cells are shown in Figs. 20 and 21.

PHOTO-EMISSIVE CELLS

From the industrial standpoint today, by far the largest number of applications fall in the field of the photo-emissive cell, an electronic tube which like the earlier conductive cell of the selenium type varies its conductivity with variations in the intensity of incident illumination. In cells of this type an electrode coated with a material capable of emitting electrons under the impingement of light serves as a cathode, while a nearby wire electrode serves as an anode. When light falls upon the cathode, electrons are liberated. These electrons are attracted to the positively charged anode and an electron flow from cathode to anode takes place. The number of electrons available is dependent upon the illumination and the potential difference between the electrodes.

The discovery of photo-emission goes back to observations made by Hertz in 1885-7, when he was experimenting with what was to become the groundwork of wireless. He noted that the maximum intensity of spark at the receiving gap was obtained when the gap was irradiated with ultra-violet light. In 1888 Hallwachs tested the effect of ultra-violet on a charged gold-leaf electroscope and found that such radiation quickly dissipated a negative charge but had no effect on a positive charge. The following year Stoletow interposed a mesh screen between an arc light and a highly polished metal plate, connecting the plate and screen in series with a battery and galvanometer, an arrangement quite similar to a modern photo-emissive cell. When the plate was irradiated, he found that a small current flowed from the plate to the screen.

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In 1890, two experimenters, Elster and Geitel, studied the photo-sensitivity of various metals, and found that the more electro-positive metals gave the best results. To use the alkali metals, sodium and potassium, they made mercury amalgams which gave excellent results with visible light, as well as ultra-violet, especially when the cell was inclosed in a highly evacuated glass tube. Thus they showed that both the Hallwachs and Hertzian effects were caused by the liberation of negative electrons from a photoelectrically sensitive substance, by the impingement of light on the substance.

In its modern development, the photo-emissive cell has appeared in two different forms, the high-vacuum and the gas-filled types, just as the electronic tube has developed in both directions. The high-vacuum photo-emissive cell, like the high-vacuum electronic tube, is simpler in its general function. This cell consists essentially of a half cylinder of metal upon which an alkali metal is deposited. This cathode is mounted within an evacuated glass bulb. Placed parallel to and along the center axis of the half cylinder, and insulated from it, is a wire electrode which serves as the anode. When light impinges upon the cathode, electrons are given off from the surface of the alkali metal and flow toward the positively charged anode. Since there would be no flow without a potential difference between anode and cathode, a battery must be provided in the external circuit to keep the anode positive with respect to the cathode.

Cells of this type are the most useful of all photoelectric devices. They may be designed for an output directly proportional to the illumination. In addition, they are decidedly free of fatigue effects. Having high internal impedance, they operate satisfactorily with a variety of amplification methods. Their sole disadvantage is that their output is quite small, although this disadvantage is not serious in view of the excellent electronic amplifiers now available. A tube of this type is illustrated in Fig. 19.

GAS-FILLED PHOTO CELLS

In some ways, the gas-filled photo-emissive cell resembles the gas-filled electronic tube already discussed. In both cases the presence of gas molecules in the tube results in ionization of the molecules, with the production of additional electrons and a considerable increase in the available electron current from cathode to anode. This cell is similar in construction to the high-vacuum photo-emissive cell except for the traces of gas present in the inclosure. In one commonly employed type, the cell is evacuated and then filled with argon to a pressure of 100 microns.

The number of ionizing collisions which may take place within such a cell obviously depends upon the number of electrons issuing from the cathode and hence upon the amount of light impinging on the cathode. Since the possibilities for collision depend also on the number of electrons actually leaving the vicinity of the cathode, the difference in potential between anode and cathode is also a determining factor. Once these factors are fixed, the number of collisions determines the number of additional electrons produced. The result of this process of gas amplification is the loss of linear relation between the light and the current output. This disadvantage is not especially serious in the case of control equipment, but may be important in certain other applications.

Another more serious disadvantage is the possibility of initiating a glow discharge, similar to that resulting from triggering a gas-filled electronic tube into the self-ionizing state. The ionization potential of the gas is generally in the neighborhood of 90 to 100 volts, and as the anode voltage approaches this potential, a glow discharge is produced, similar to the discharge in a neon tube. Hence an anode current will flow, even when the cathode is not illuminated. This current may increase to such a degree that the tube will be injured if external resistance is not placed in the anode circuit. On that account it is customary to use a resistance of 100,000 ohms or more in series with gas-filled photo-emissive tubes. However, this is not disadvantageous since a resistor is required for coupling such a tube to the types of amplifier customarily used with it.

Another disadvantage of the gas-filled tube is that, unlike the high-vacuum photo tube, which responds instantly to changes in light density, the gas-filled type shows a definite time lag. This is caused by the relatively large mass of the positive ions which require appreciable time to move from the vicinity of the anode, to the cathode, where they liberate additional electrons. At first the anode current rapidly increases with illumination, but gradually reaches an equilibrium value. A similar though reverse effect is obtained when the illumination is removed. The tube again exhibits inertia and the current does not fall instantly.

For most control purposes the lag of a gas-filled photo-emissive cell is unimportant. The cell is obviously inferior to the high vacuum photo tube in respect to its responsiveness, but its gas amplification gives it a place in industrial apparatus. Comparative performances of various photocell types are plotted in Figs. 22 and 23.

(*Editor's Note:* As explained in the earlier part of this paper, a second article will follow in our April issue.)

Machinery, Materials and Products

CHEM & MET PROCESS EQUIPMENT NEWS

Asbestos-Cement Building

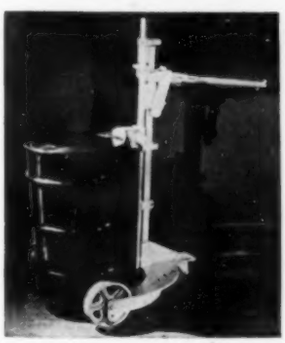
IN ANTICIPATION of shortages of metals used in building construction, Keasbey & Mattison Co., Ambler, Pa., has experimented with and finally announced an all-asbestos-cement building, employing asbestos-cement tubular sections as the structural members, sheet asbestos for the side walls and corrugated asbestos sheathing for the roof. Such buildings are based on units 16 ft. long and 12 ft. wide, with 15 ft. of clear height. Thus a building of any size can be constructed by simply combining the required number of 12x16-ft. units. It is pointed out by the manufacturer that installation can be handled by unskilled workmen, thus keeping erection costs at a minimum. Such buildings are said to be fire-resisting, weather-resisting and free from maintenance.

Sand-Bag Filler

A SIMPLE, light-weight device, available at low cost for the easy filling of sand bags has been announced by Spinks Scale Co., 656 Mayland Ave., S. W., Atlanta, Ga. This filler, a development of this company's previously manufactured coal-bag filler, is said to enable one man to fill more sand bags per day than two men can fill when one holds the bag, and the other shovels. The filler allows the bag to rest on the ground while being filled so that it can readily be removed from the filled bag without lifting the bag, thus allowing row after row of bags to be filled around a pile of sand. Bags are tied where filled and not handled until ready to be used, thus lessening fatigue and resulting in increased production. The manufacturer states that the most economical way of filling sand bags is to dump the sand near the location where the bags are to be used, filling the bags there. Thus these heavy, unwieldy packages need be handled only once in placing them in the desired position, as compared with the extra handling and trucking required when bags are filled at a point other than that where they are to be used.

Asbestos-cement building

Heavy-drum carrier



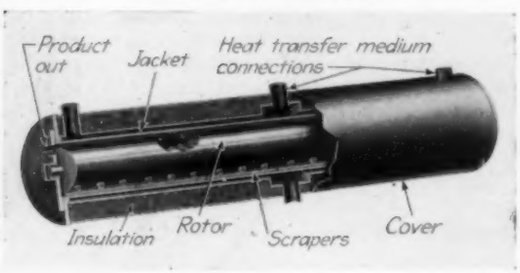
Heat Transfer Device

CONTINUOUS OPERATION under pressure in a closed system, and extremely rapid heat transfer rates, are features of the Votator, manufactured by the Votator Division of The Girdler Corp., Louisville, Ky. Developed for rapid cooling in the vegetable shortening, margarine, lard and ice cream industries, the company is now offering this heat transfer mechanism for use in numerous other industries where liquids and viscous materials are to be heated or cooled with extreme speed. The device employs a very high ratio of transfer surface to volume of material undergoing treatment, and maintains its high heat transfer rate continuously by the use of rotating scrapers which remove the film of material from the heat transfer surface. As shown in the accompanying illustration, the machine consists of a jacketed vessel of small diameter in relation to its length, the jacket being heavily insulated and adapted to the handling of either high or low temperature heat transfer media. Within the vessel is a rotating element carrying scraper blades. This element, known as the Mutator shaft, serves not only to carry the scraper blades but, equally important, acts as a filler so as to reduce the working volume to the small annular space between the vessel wall and the Mutator shaft.

Owing to these features, the manufacturer claims that extremely high K values may be secured, together with uniform temperatures throughout the product, and accurate temperature control. Ordinarily a wide range of temperature change may be obtained in the product in the matter of a few seconds. So rapid is the heat transfer that many products can be super-cooled well below the crystallization point and discharged in a liquid state. Furthermore this can be done out of contact with the atmosphere and, if desired, predetermined quantities of gas may be incorporated into the product or the Votator can be used to make a uniform mixture or emulsion during the heat transfer process. The mechanism is adapted to various piping hook-ups and can, if desired, be employed in multiple assemblies for both heating and cooling. Standard sizes and designs are available, as well as individually engineered units.

One-man sand-bag filler

Cutaway view of Votator

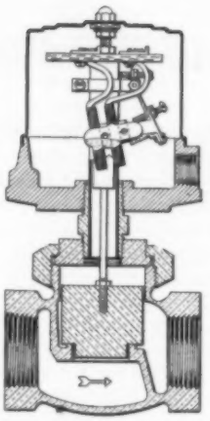


Drum Carrier

A NEW DRUM CARRIER with a capacity up to 600 lb., designed especially for the handling of heavy drums and known as the Little Giant, has been announced by Ernst Magic Carrier Sales Co., 1456 Jefferson Ave., Buffalo, N. Y. One man using one hand to operate one of these carriers is claimed to take the place of several men formerly required to break-over, balance and move the drum. The simple lifting device and self-balancing three-wheel construction are said to eliminate possibility of accidents. Special non-sparking wheels are available where precautions against explosions are necessary.

Flow Alarm

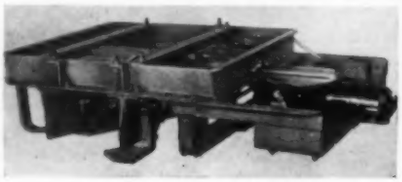
A NEW ITEM recently added to the Magnetrol liquid-level-control line of Fred H. Schaub Engineering Co., 325 West Huron St., Chicago, Ill., is a flow alarm designed to signal starting, stopping or insufficient flow of water, oil, gas or air. Built in pipe sizes from ¾ to 4 in., the device is designed for maximum operating pressure of 400 lb. W.O.G. It consists of a globe valve body to which is attached a head containing one of this company's Magnetrol magnetic switching devices. A plunger within the valve is raised off its seat by the flowing fluid, its motion being transmitted magnetically through a nonmagnetic tube closed at its upper end to a mercury switch which completes the circuit when the flow drops to approximately 10 percent of the maximum flow for which the unit is designed. Special units can be built to give an alarm for any predetermined rate of flow less than maximum. It will be noted that through use of the magnetic transmission the valve requires no stuffing box.



Magnetic flow alarm

Electric Track Switch

FOR USE on cab-operated, gravity and automatic dispatch overhead material handling systems, the Cleveland Tramrail Division of the Cleveland Crane & Engineering Co., Wickliffe, Ohio, has developed a new electrically operated track switch designated as motor driven Type H. This development enables the operator to pre-set the switch at some distance ahead while traveling, thus saving time lost in hand-switching. If desired, indexes on gravity or automatic dispatch carriers may be set to actuate trippers which will cause one or several switches to take the positions desired. Ruggedly built of welded steel, the switch consists of an outer supporting frame and an inner sliding frame. The former element may be bolted rigidly to the superstructure, while the latter, riding on multiple easy-operating rollers, carries a straight and a curved rail and is set in position by a motor-driven cam through a lever arrangement.



Electrically operated track switch

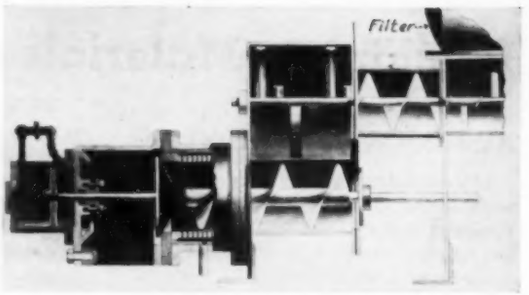
Continuous Pressure Filter

WHAT IS DESCRIBED by the manufacturer as the first continuous pressure filter, is the McCaskell automatic rotary leaf pressure filter developed by Goslin-Birmingham Mfg. Co., Birmingham, Ala. This machine makes possible continuous cake building, washing, drying, and discharge under higher differential pressures than are available with vacuum filters. It is claimed to be able to handle volatile solvents, corrosive liquids and viscous and high temperature slurries in a totally inclosed continuous pressure cycle. Economies in space, labor and maintenance, higher rates of flow, and the ability to dry the cake by air or steam pressure are characteristics claimed for the new filter press.

The McCaskell design follows that of this company's Vallez rotary pressure-leaf filter in general construction, employing a number of round filter leaves spaced at regular intervals along a shaft, each leaf made up of pie-shaped sectors from which the filtrate drains into an individual port through a hollow filter shaft and an automatic disk-type filter valve. Contrary to usual rotary pressure-leaf filter operation, however, the new filter operates with partial rather than complete submergence, with pressure applied to the liquid and the submerged elements by air or gas pressure in the upper filter body. A low initial pressure with regulated increase to full differential pressure over the cake-building cycle is provided for by bleeder valve control of the leaf segments, which is said to result in exceptional clarity of filtrate. A continuous spray applied to the rotating leaves above the liquor level provides for washing. Cake discharge proceeds continuously as the leaf elements rotate past a hopper, discharge being accomplished by a pulsating reverse flow. Cake falls from the hoppers into a scroll conveyor, while a hydraulically loaded floating cake discharge valve unloads the cake continuously from the scroll compression cylinder without loss of pressure.

As shown in the accompanying cross-section of the discharge mechanism, a vacuum de-airing chamber can be provided in the discharge in case of products which must be de-aired or de-gassed.

These filters are available in a range of standard sizes from 20 to 600 sq.ft. of filter area, in a wide variety of construction materials.



Discharge mechanism of McCaskell continuous filter

Saboteurs are blinded by new anti-sabotage luminaire

Anti-Sabotage Light

GLARE, ordinarily anathema to lighting engineers, is made use of by Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., in a new anti-sabotage luminaire lighting fixture to blind would-be intruders, while permitting guards of defense plants to remain inconspicuous in the shadows. The new fixture employs a Fresnel lens which throws a flat, fan-shaped beam of light. When a row of these luminaires is set on posts several feet away from the buildings to be protected, their light is projected slightly downward and away from the buildings, leaving the space between the luminaires and the buildings virtually in darkness. Intruders are clearly visible but guards behind the lights cannot be seen.

Automatic Molding Press

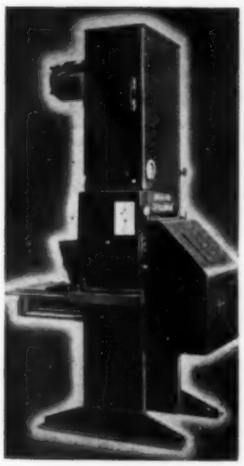
TO PROVIDE faster molding of plastic products than has hitherto been possible with a machine of this capacity, Watson-Stillman Co., Roselle, N. J., has developed an improved 75-ton fully automatic compression molding machine capable of handling an 18x18-in. die. Powered by a 5-hp. motor, the unit has a 10-in. stroke with an approach speed of 210 in. per min., a pressing speed of 3.3 in. per min., and a return of 140 in. per min. All settings for time periods, materials, quantities and pressures can be made independently and easily from a single control panel. The hydraulically operated feeder puts a predetermined quantity of material in each mold cavity,

after which the molds are closed under pressure, and high pressure applied automatically at a predetermined time. Molds can be de-gassed if necessary. Pieces are then stripped and blown down a chute to an automatic piece-weighing scale. Work which fails to strip off automatically rings an alarm.

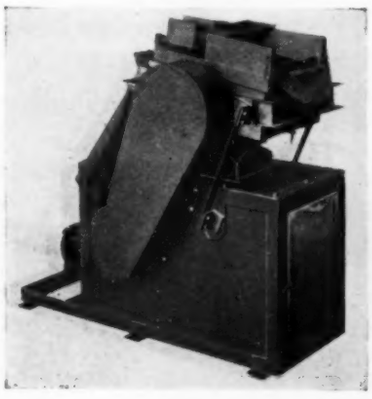
Specific Gravity Separator

AIR FLOTATION for the separation of high-gravity materials, such as stone, glass, and metals, from seeds and grains such as soybeans, corn and other cereals, is accomplished by the new Air-Float Stoner developed by Sutton, Steele & Steele, Inc., Dallas, Tex. Extremely high separating efficiency with very large capacity per unit of power expended is claimed for the new machine. Separation is effected by difference between the bulk density of the stock and its contaminations. The stock flows downward over a rapidly oscillating sloping screen deck, on a cushion of air supplied by a blower beneath the deck. Materials of higher specific gravity work uphill and leave through a throat at the high side of the deck. Power required is low since the machine does not have to lift the entire mass of material simply to remove a small percentage of heavy contamination. Instead, the material flows downhill in a fluid condition, while higher gravity substances sink through the mass and work uphill, against the flow of stock. Up to 16 tons per hour capacity is claimed for a single standard size separator, with a power consumption of about 0.6 hp. per ton per hour capacity.

75-ton automatic molding press



Air-Float Stoner



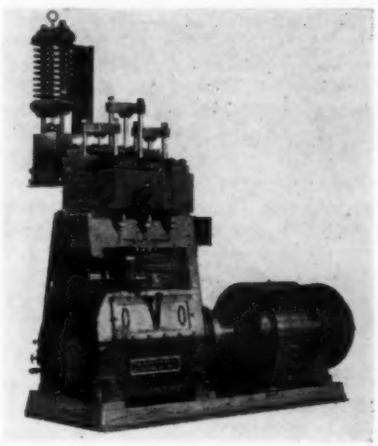
Compact Fork Truck

ALTHOUGH LIGHT in weight to permit it to operate over weak floor constructions, the new Clipper type gas-powered fork truck built by Clark Tructractor Division of Clark Equipment Co., Battle Creek, Mich., is available in capacities of 1,000, 1,500 and 2,000 lb. The truck is built in six models with standard finger lifting heights of 60 to 108 in., with other heights optional. It is compact in design and able, according to the manufacturer, to operate on a continuous 24-hour basis in congested areas. It features front-wheel drive, rear-wheel steer, hydraulic lift, tilt and braking, and a self-starter. Safe operation at speeds from 1 to 7 m.p.h., forward or reverse, is claimed.

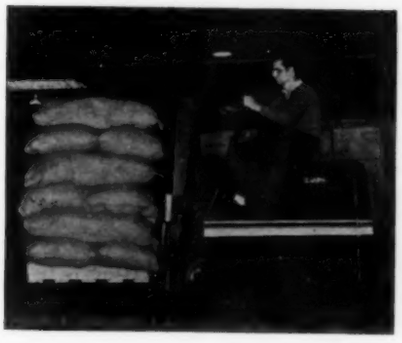
Power Pump

A NEW LINE of high-pressure, vertical, triplex constant-stroke pumps has been announced by Aldrich Pump Co., Allentown, Pa. Available in sizes from 10 to 150 hp., these pumps are designed for pressures up to 9,800 lb. per sq. in., in capacities to 220 g.p.m. Drive is by gear-head motor or speed reducer, with provision in the larger sizes for the use of built-in gearing, or belt drive direct to the crankshaft. When desired, as for use in connection with a central hydraulic accumulator system serving several presses in constant operation, these pumps can be fitted with this company's synchronized suction valve control. For special process work at high pressure, as in oil refining and certain chemical industries, the outboard plungers are sealed dust- and weather-tight, with a removable cover.

Vertical, triplex high-pressure pump



Compact fork-type truck



Equipment Briefs

MANY NEW FEATURES are said to be incorporated in the latest centralized lubrication system announced by Lincoln Engineering Co., 5701 Natural Bridge Ave., St. Louis, Mo. The system, the Centro-Matic, consists of a number of injectors, one for each bearing to be lubricated, each connected to the bearing by tubing or flexible high-pressure hose, and each individually adjusted to discharge the required amount of lubricant. The injectors can be mounted singly or in manifold and are supplied with lubricant from a central pumping unit. A single lubricant supply line between the pumping unit and the injectors is an important feature, another being the wide range of pumping unit types available.

A NEW high-powered communicator for contacting selectively up to 20 substations, or paging all substations simultaneously, has been announced by Executone, Inc., 415 Lexington Ave., New York, N. Y. With this new model, natural two-way conversations are instantly possible. The station is inclosed in a 10x12x9-in. cabinet, with built-in microphone and speaker, and buttons for calling the 20 substations. The latter can be private, i.e., equipped with earphones, or remote, to permit conversation with a man many feet from his station.

A SIMPLE DEVICE to permit rapid soldering of electric wiring is the Jigger, a self-contained soldering unit recently introduced by Jiggers, Inc., 215 West Illinois St., Chicago, Ill. Each Jigger, which is slipped over the ends of the wires to be soldered, consists of solder and flux hermetically sealed in a waterproof, heat-generating outer shell. When the Jigger is touched with a lighted match, it ignites and produces the proper temperature to flow the solder into the splice. The burnt shell is then dropped off and the correctly soldered splice revealed.

AN IMPROVED and simplified design of its system for controlling arc welding machines, which eliminates the need for meters showing volts and amperes, has been announced by Lincoln Electric Co., Cleveland, Ohio. The

new system employs a job selector dial and a current control dial, calibrated and equipped with a handle and pointer. It is claimed that the welding operator can quickly select the proper combination for highest quality welds and highest possible welding speed, because he can vary both the slope of the volt-ampere curve and the amount of welding current, independently and positively, to suit every job encountered. Both voltage control (job selector) and current control are continuous in operation, making possible thousands of possible combinations of voltage and current.

UNIVERSAL HOSE TOOL is the name of a new hose-clamp-applying device for use on both rubber and fabric hose, recently announced by American Machine & Metals, Inc., East Moline, Ill. The tool bends the hose band around the hose, then by turning a small wheel and pushing it down, the band is clinched firmly, leaving a permanent sturdy connection. In three simple operations, hose couplings can be made in a few minutes on liquid, gas or air hose. Two sizes are available, the larger for 1–3 in. hose and the smaller ¼–¾ in. hose. In addition to saving time, the new tool is said to decrease the necessary clamp stock materially.

FURTHER IMPROVEMENT in fluorescent lighting is said now to be available for the production of essential military and civilian materials through the use of the new RF lighting equipment introduced by Benjamin Electric Mfg. Co., Des Plaines, Ill. The new equipment is said to provide even more light for the power consumed, to provide a new solution to the flicker problem, to assure quicker starting and to reduce installation and maintenance costs. It is said to be suitable for high mountings and wide spacings. Employing twin-lamp units, 35-40 footcandles of general illumination can be provided with a power consumption of about 200 watts when installed on 10x10 ft. spacings. Employing a full-wave rectifier-type circuit, the units are said to reduce flicker to such an extent that even single-lamp units can be employed satisfactorily in many cases without special balancing devices. Lamps of 85-watt size are employed in both single- and twin-lamp types.

Turbine Pumps

A NEW LINE of small-capacity, high-pressure centrifugal pumps of the so-called turbine type, made in a variety of designs for various operating conditions, has been introduced by the Dayton-Dowd Co., Quincy, Ill. Type T, the general-purpose pump of this line, is made in sizes from 1 to 150 g.p.m., for heads up to 300 lb. and speeds to 3,600 r.p.m., while other types are available for the same capacity range and for pressures to 500 lb. and temperatures to 850 deg. F. The lower pressure pumps of the series, such as the general-purpose pump and the 250-lb. high temperature pump, employ an overhung rotor with a single stuffing box, while the 500-lb. low and high temperature pumps carry the rotors on bearings at either end, thus requiring two stuffing boxes.

These pumps are of the type operating on the regenerative principle, in which a single multi-vaned impeller operates at normal speeds to develop extremely high pressure in a single-stage casing. The head characteristics are especially flexible and motor overloading is said to be impossible, if the pump is selected for the maximum head conditions, as power decreases as the head decreases. The pumps develop a high suction lift, up to 28 ft., while the type of construction employed facilitates the use of special alloys and permits easy repairs. An extra set of side plates and an impeller can be stocked for ready replacement.

Another feature of the design is that the stuffing box is located in the area of lowest pressure within the pump. The pumps are inherently self-priming and capable of handling volatile liquids without becoming vapor-bound. All models employ anti-friction bearings and make provision for micrometer adjustment of the impeller clearance. For the higher pressure pumps, a built-in bypass and relief valve may be provided if required. In the case of the higher temperature pumps, both bearings and stuffing boxes are water-cooled.

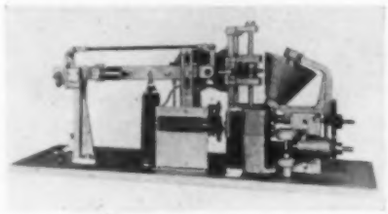
Corrosion-Resisting Valves

MATERIAL INCREASE in its productive capacity for corrosion-resisting valves has been announced by Jenkins Bros., 80 White St., New York, N. Y. The company is thus in a position to offer faster delivery on such valves for orders having high priority ratings. In addition to globe, angle Y and check valves, the line now includes solid-wedge and double-disk-taper-seat gate valves in sizes up to 6 in. The company is now certifying its valve castings, employing both X-ray and pressure tests on each casting.

Conveyor Scale

A NEW SYSTEM for the integration of weight of material passing over a conveyor scale has been developed by Fairbanks, Morse & Co., 600 South Michigan Ave., Chicago, Ill. The integrator is of a simple design, which takes simultaneous account of the instantaneous weight on a scale-balanced section of the conveyor belt, and of the belt speed, converting these two functions into velocities which are applied to a differential gear, the output of which drives the integrator. The scale beam operates between close-spaced electric contacts on a movable contact table powered by a fractional-horsepower reversible motor. The function of this mechanism is to position a roller on a vertical shaft in the same vertical position as that at which the scale beam balances. The roller is driven by contact with a cone pulley driven from the conveyor belt. The conveyor belt drives one side of the differential at a speed proportional to the belt speed. The roller drives the other side at a speed proportional to the instantaneous weight on the belt. Therefore, the differential output is proportional to the weight passing per unit of time and is so recorded. Through the use of a Selsyn motor, operated by the integrator, a remote integrator can be employed, as well as a remote recorder, if desired. The scale is fully automatic in operation and requires no attendance.

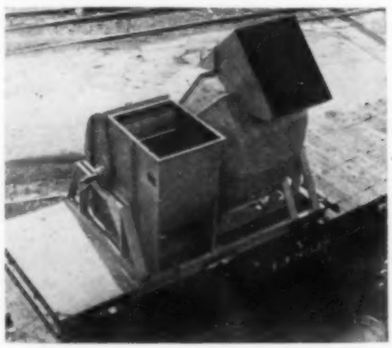
Integrating conveyor scale



Blackout Fan

ALTHOUGH it was developed primarily for the collection of fly-ash from cupolas and similar equipment, the new Filtre Fan announced by Claude B. Schneible Co., Chicago, Ill., has been found to be extremely effective, according to the manufacturer, in reducing all glow from fired equipment which would otherwise be visible from the air. As is shown in the accompanying illustration, the unit is a dry-type collector, comprising a centrifugal collection chamber in series with a fan. The reverse in direction of gases passing through the apparatus prevents direct visibility of the fire, while the provision which is made for diluting the gases with air not only lowers their temperature to a point where they can be handled safely by the fan, but prevents any possibility of luminous gas passing through the equipment. The device, which is available in a variety of capacities, is of unit construction, mounted on a bed plate providing space for the belted motor. To maintain low bearing temperatures, the through shaft is water-cooled.

Blackout fly-ash collector



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8. ELIMINATION OF FAILURES
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11. NO SPOILAGE
12. PRACTICALLY ZERO IN MAINTENANCE COSTS

You can find out full details on all of these 12 points by reading Bulletin "1000"—send for it.

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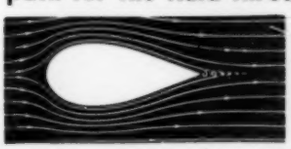
Whether you are operating one, two, or three shifts a day, the "1000" valve, through "Streamlined" performance, is a valuable factor in aiding in smooth operation, high production, and better quality results. Check the twelve points and you will see that you get every advantage in pressure reduction for steam, air, oil—most anything that flows. The "1000" valve stays on the job for years rendering remarkable service — all without giving trouble. The Streamlined flow around the inner valve eliminates turbulence, thereby giving you best control under varying loads. You get better pressure control and greater capacity because there's a straight path for the fluid through the flow tube.

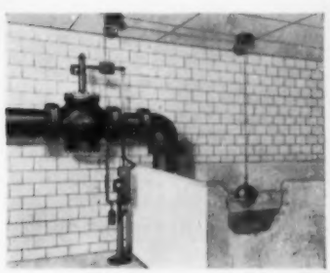


HERE'S THE "1000" FLOW PATTERN
The Streamlined form of the inner valve eliminates turbulence. It produces the flow pattern shown at left which makes for maximum capacity when it is needed most and permits accurate pressure control under toughest working conditions.

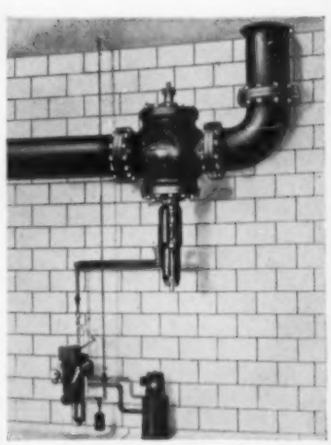
A CASH STANDARD "GET ACQUAINTED" COLUMN

Question: **"Don't you people make anything besides that Streamlined Valve you talk about so much?"**

Answer: **"Yes Sir; we do! And we propose to picture one or two of them here each time."**



In automatic liquid level control, two things are often of prime importance: (1) to hold the level within the closest kind of limits; (2) to do it dependably, day by day. How Cash Standard controls do both is shown above. A Type 100-L Controller operates a 12" Balanced Valve regulating liquid supply to a large tank. It is pilot actuated for sensitivity. It has operating power to spare—for any size Valve, however large.



Here, a Type 100-L Controller operates a 10" Cash Standard Balanced Valve. It regulates flow through a make-up line to a "dirty water" heater on the floor above. The lever of the "100-L" responds to slightest movement of a float in the heater—causing immediate movement of the power piston which operates the Valve. But there is no "hunting" because the Controller is fully compensated. It has a "range" adjustment too. It gets accurate results with any size valve—no matter how small or how large the valve may be. It is simply a matter of using the right size power cylinder.

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CONTROLS.. VALVES

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Naval Stores and Terpene Chemicals

ONE OF THE PIONEERS in the recovery of naval stores (turpentine and rosin) from cutover Southern pine forests, was the Newport Industries, Inc., the first commercial operation starting in 1913. The Pensacola, Fla., plant can process 500 tons of wood daily and is the largest of the company's three properties.

Stumps are delivered by rail and truck. After grinding, the wood is carried on belt conveyors either directly to extractors or via storage bins. Preheated, close-cut petroleum naphtha (dry point about 115 deg. C.) extracts all the valuable products. The spent chips are steamed in order to remove solvent and then conveyed to boilers where they are used as fuel, or delivered to a plant adjoining the Newport operation for fabricating into building and insulating board.

FF wood rosin is the still residue after distillation of the extract to separate solvent and all the natural oils recovered from the wood. Most of the FF rosin is redissolved in petroleum naphtha and the solution filtered cold through adsorbent earth. Any desired degree of decolorization of the rosin is obtained.

The pale rosins are pumped as hot liquid to various departments for processing into specialty products. The treatments include Dowtherm controlled, high-temperature, partial vacuum distillation, chemical reaction with lime and/or zinc oxide and combinations of these. Catalytic partial polymerization is an important recent rosin development.

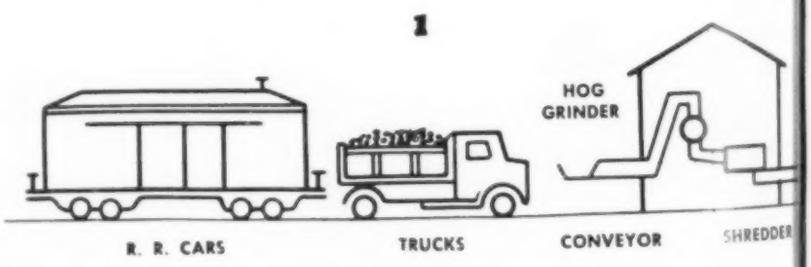
Turpentine, dipentene and pine oil are separated from each other and from the petroleum solvent by vacuum fractionation in packed columns. Turpentine is refractionated to recover pinene used for the production of synthetic camphor by others. Pine Oil is chemically processed at the Pensacola plant to produce alpha and beta terpineol, anethol (N.F.), camphor (U.S.P.), fenchone and technical terpin hydrate. Dipentene will be processed in a plant under construction to make para-cymene, para-menthane, methyl tolyl carbinol, methyl acetophenone, para-methyl alpha-methyl styrene and isopropyl benzoic (cumic) acid—many of them new turpene industrial chemicals. Terpene hydrocarbons in pine stumpwood are the raw material for isoprene by a new process also to be in operation next year.

CHEMICAL & METALLURGICAL ENGINEERING

March, 1942

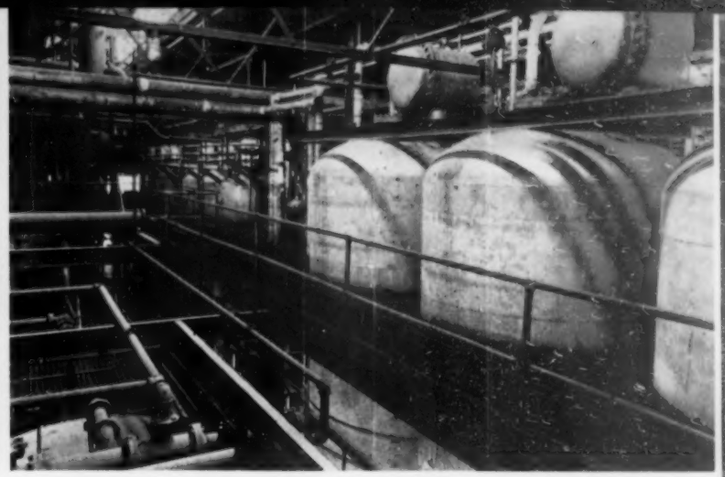
PAGES 112-3 to 115-3

1 An elaborate conveying system is used for delivering the stump wood from the storage piles to the hog grinders and shredders

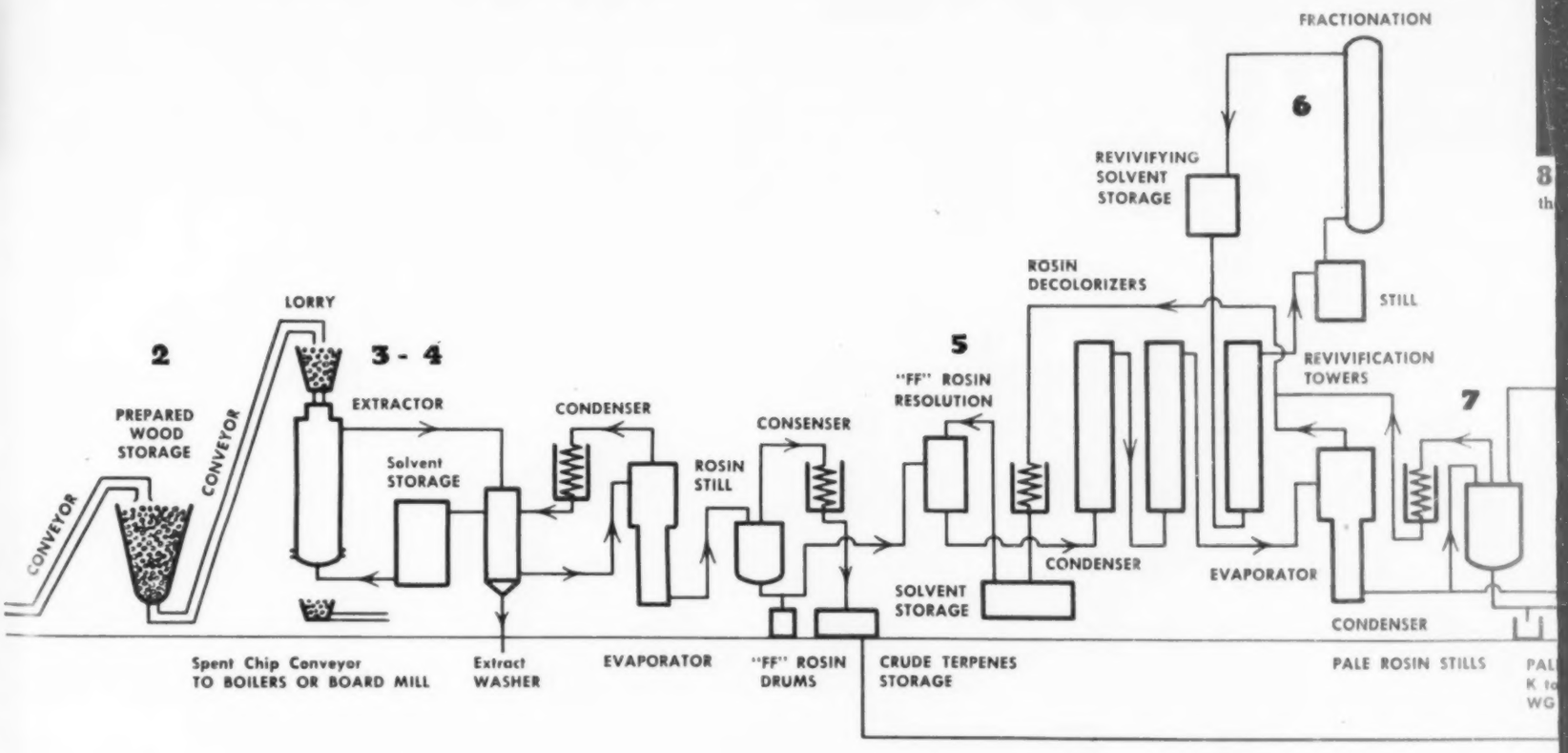


2 Production of naval stores at the Pensacola, Fla., plant of Newport Industries, Inc., starts with the delivery of stump wood in trucks and railroad cars

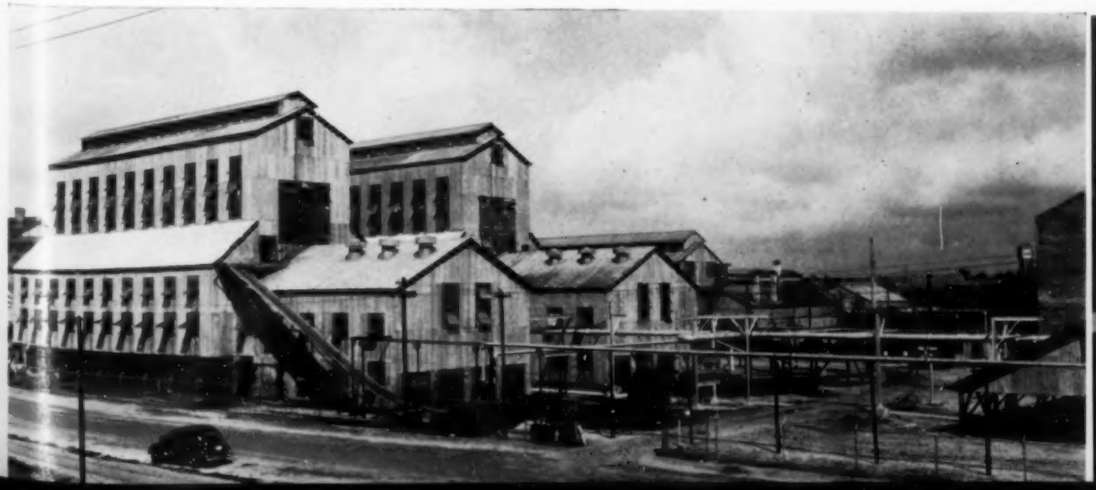
4 Lorrys are used to convey the wood from the storage bins to the extractors. A lorry may be seen in the upper left hand corner of the charging floor above tops of extractors



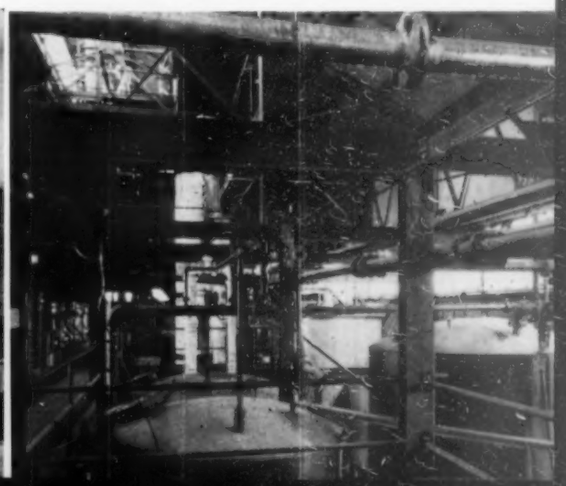
6 FF rosin is redissolved in petroleum naphtha and the solution filtered cold through adsorbant earth in this battery of towers



3 Shredded wood is conveyed by belt directly to extractors or via storage bins. This conveyor and the extractor building are shown in the left foreground of this portion of the plant



5 Extract is evaporated and spent chips are steamed solvent. Evaporators and FF rosin re-solution equipment



he solution filtered
rs

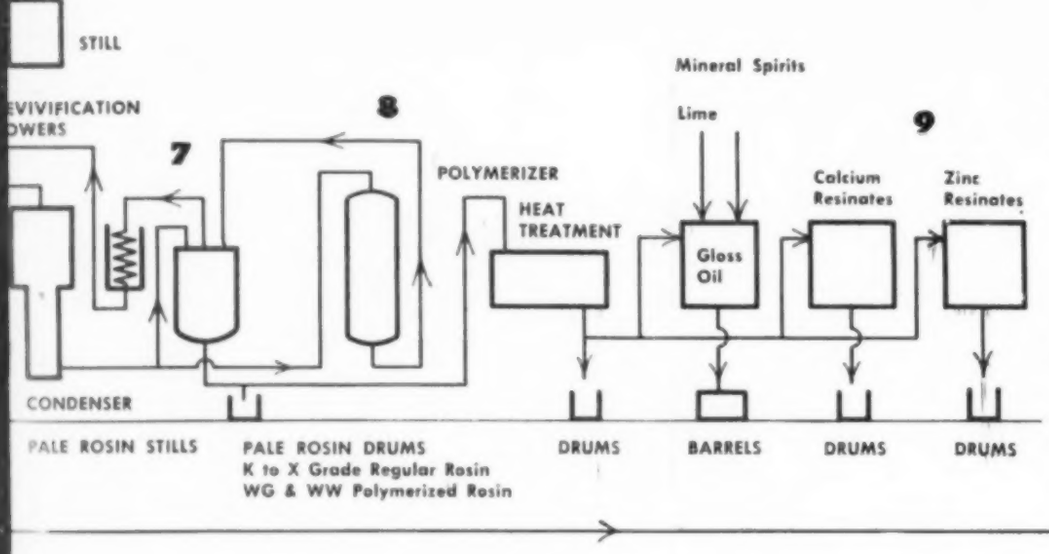
8 Pale rosins are converted by catalytic partial polymerization in these reactors into specialty products

10 Terpentine, dipentene and pine oil are separated from ea from the petroleum solvent by vacuum fractionation in packed

ACTIONATION

STILL

EVIVIFICATION
OWERS

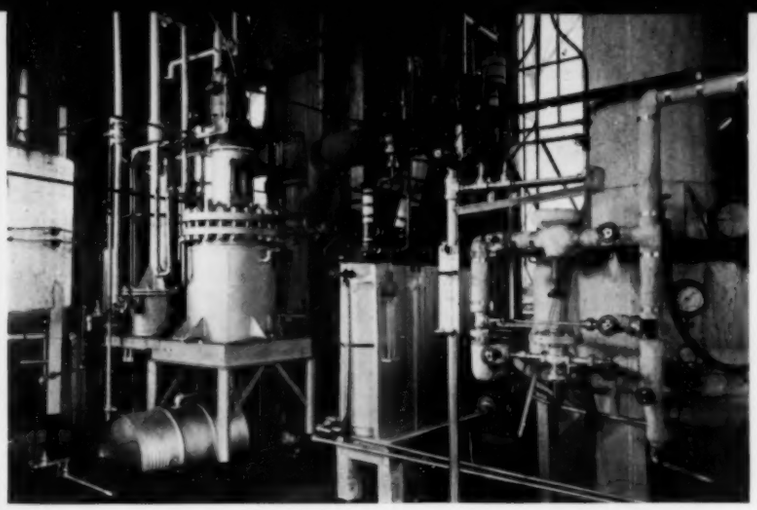


spent chips are steamed to remove
osin re-solution equipment are shown

7 Liquid rosin from the finishing stills is pumped to elevated horizontal tanks shown in the background, from which it is run into 500-lb. galvanized drums cooling in the foreground

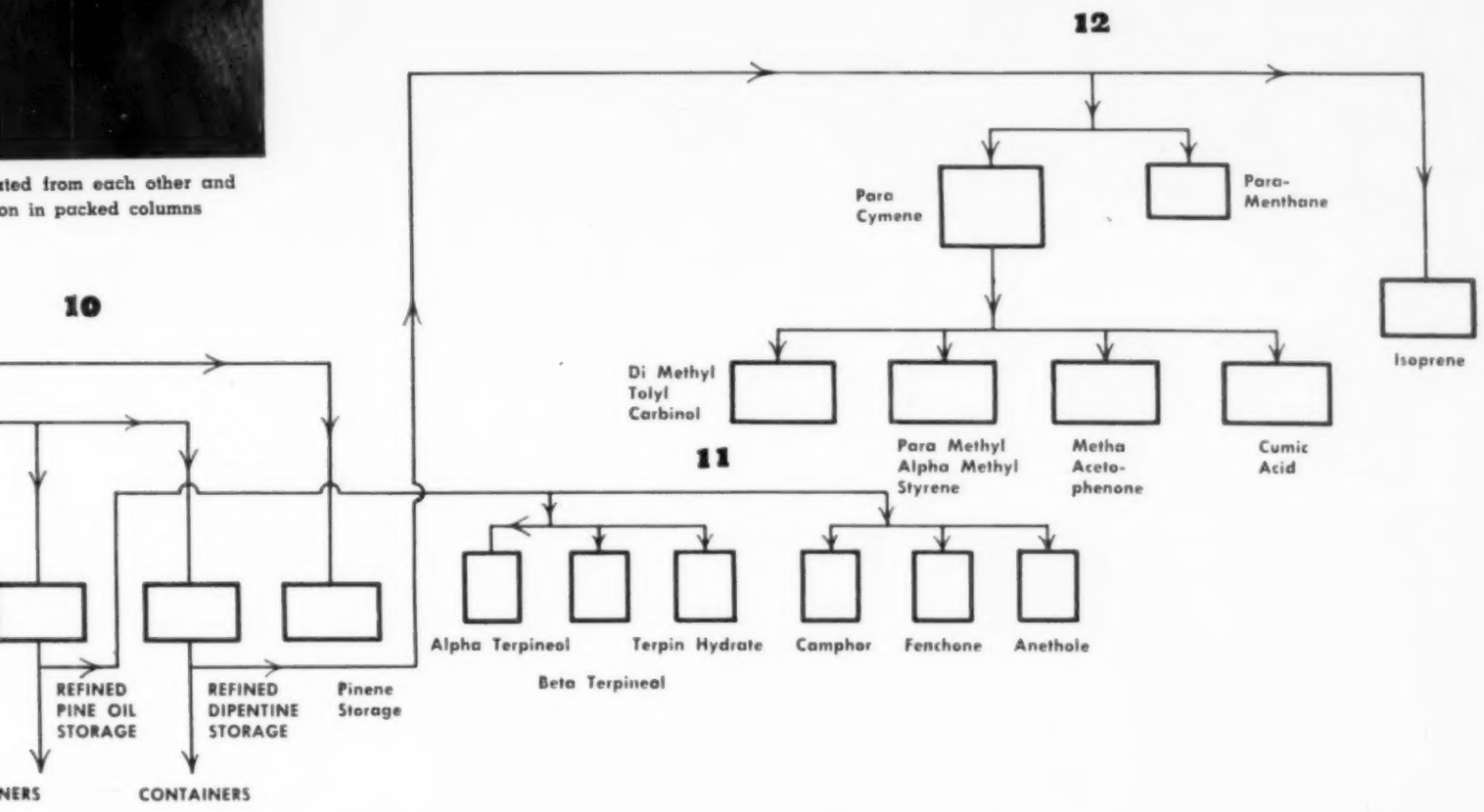
9 Pale rosins ar
vacuum distillatio

ated from each other and
on in packed columns



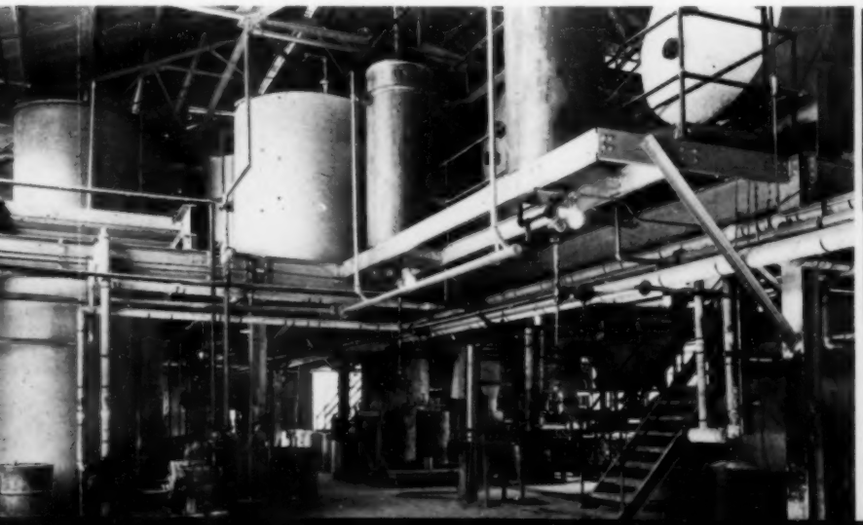
12 Pilot plant used for developing processes to produce new terpene chemicals and isoprene shortly to be in commercial production

A *Chem & Met* **FLOW SHEET**



ale rosins are also converted into specialties by high temperature treatment, partial
um distillation, reaction with lime and/or zinc oxide and combinations of these

11 Operating floor, showing high vacuum stills and receivers in the plant producing comphor, anethol and terpineol



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• Reclamation of strategic materials is vital to war production because every ton of loss prevented means tons less of raw materials required. Turbulaire Spray Dyers are reclaiming Magnesium Chloride from a plant's waste liquors, high-vitamin stock food from Molasses residue, Yeast from brewery waste. They are used in the processing of Magnesium Chloride, resins, in the ceramic field for the cleaning of clay, and for many other uses in the food and chemical fields. Back of every Turbulaire Dryer stands the technical skill and experience that assures extremely efficient operation of each unit of its rated capacity.

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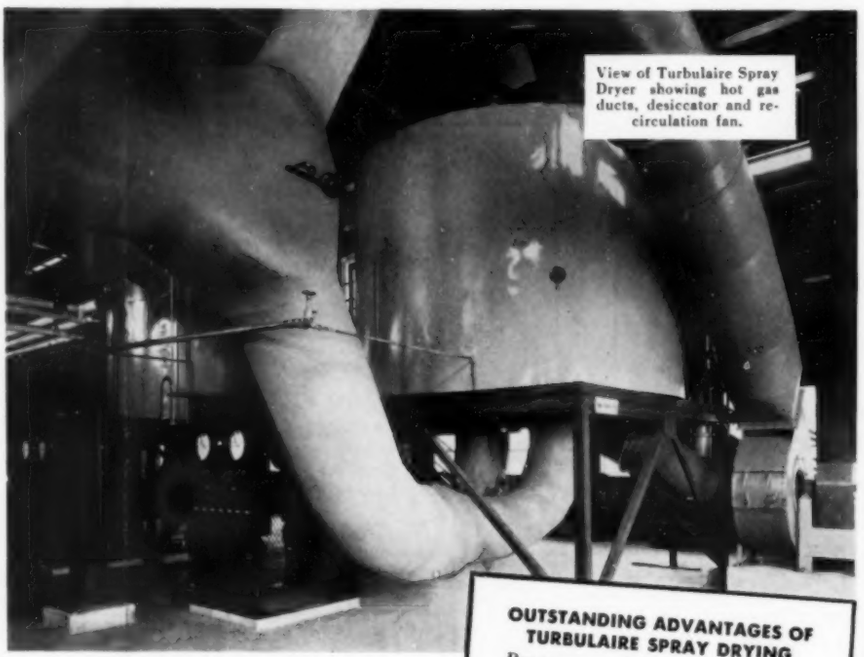
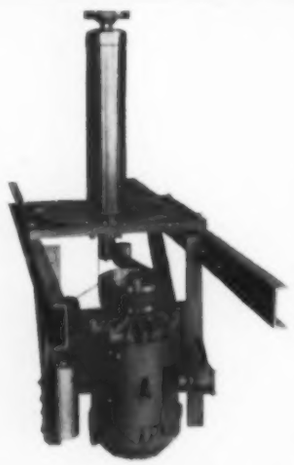


View of Turbulaire Spray Dryer showing hot gas ducts, desiccator and recirculation fan.



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TIPS ON VALVE TRIM
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IT'S THE TRIM THAT COUNTS!
DISC
STEM
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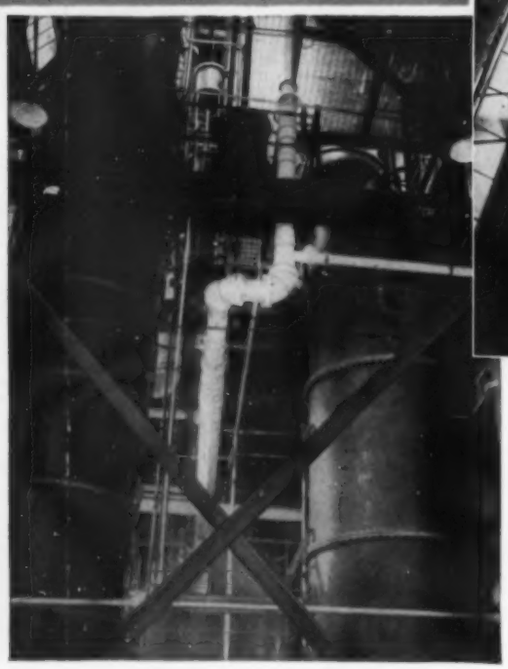

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Technical, Industrial, Personal

CHEM & MET NEWS

ALUMINUM AND MAGNESIUM PROGRAM EXPANDED

Large-scale production of magnesium from two ferro-silicon processes has been decided upon by the War Production Board both as a means of minimizing dependancy upon electric process power and to step up the national output sooner. This was announced at the end of February by Materials Director W. L. Batt in disclosing that to meet the President's war production goals aluminum capacity is being stepped up to 1,050,000 tons and magnesium to 725,000,000 pounds annually, with the deadline set for early 1943.

The increase in aluminum production over previous goals is 640,000,000 pounds, virtually all of which is to be located in metropolitan centers using high-cost steam power reserve capacities. Exact sites had not been selected early in March, but New York, Philadelphia and Boston seemed assured of large plants.

The increase in the magnesium sights is 325,000,000 pounds, nearly doubling the previous goal which in itself was more than 10 times pre-war output. Six contracts for producing 175,000,000 pounds of magnesium by an improved Pidgeon and the Union Carbide and Carbon ferro-silicon processes and 36,000,000 pounds by the standard electrolytic process had been signed at the first of March. In addition to Union Carbide, other operators will be American Metals Co., National Lead Co., Ford Motor Co., Permanente Corp., and New England Lime Co.

Plant sites were not selected when the contracts were announced, but the ferro-silicon process facilities will be near sulphur free natural gas supplies to permit use of this fuel instead of electric energy. Ford's plant will be supplied with magnesium brines from newly located wells in Michigan assaying much higher magnesia content than those previously known. The Permanente operation will be ferro-silicon process, but this concern will continue operation of its 48,000,000-pound Hansgirg process plant in California although results from this operation have proved disappointing to Washington.

Both the ferro-silicon processes to be utilized carry the endorsement of the National Academy of Sciences and both are independent industrial developments, Mr. Batt emphasized. The Materials Director pointedly omitted any mention of Secretary Ickes' recent claims of being able to produce the metal from Government-developed extraction methods.

To provide raw material for the added aluminum production, a huge expansion of bauxite output is contemplated, but WPB also plans to utilize every source from which alumina can be extracted, even to developing some which have only limited life or are high cost.

In addition to the alumina and aluminum plant program, with the necessary fabricating facilities, the plan contemplates construction of new plants to produce synthetic cryolite and aluminum fluoride. These operations will be of sufficient magnitude as to make American completely independent of imports of the real materials.

All of the cost, totaling in the neighborhood of a half-billion dollars for magnesium and aluminum, will be borne by the Defense Plant Corporation which will have title to the new facilities. All of them, however, will be privately operated for the Government.

A large portion of the new construction—particularly aluminum—is admittedly in the "white elephant" economic classification insofar as post-war operation is concerned—this being particularly true of the aluminum works in high-cost power areas. In admitting this, Mr. Batt pointed out that WPB's Requirements Committee has now formally adopted the policy which has been followed for some time by the Government in war production—that of counting dollar costs secondary to the amount of materials involved and the time required.

DR. ERNEST W. REID NOW CHIEF OF W.P.B.'S CHEMICAL SECTION

Dr. Ernest W. Reid is now the chief of the War Production Board's Chemical Branch, succeeding Dr. E. R. Weidlein who remains with the branch as technical adviser in charge of the huge synthetic rubber plant construction program. Dr. Reid has been deputy chief of the branch since it was first organized in the summer of 1940, when the defense program got underway. Before coming to Washington he was senior industrial fellow at Mellon Institute, which Dr. Weidlein heads.

A new section was set up in the branch late in February, charged with the duty of locating any chemical equipment which can be put to work increasing war production. The step is designed to meet the growing fact that new equipment simply cannot be had at any price. Charles Thompson is chief of this new section, called the Plant Facilities Section. Creation of this section was the first step in a major reshuffling of the branch's assignments and functional setup.

COMPILATION OF PRIORITY ORDERS AND FORMS

The War Production Board now has available printed pamphlets listing all priority orders and applicable forms through February 15, and is inaugurating a weekly release service to keep the compilation up to date. Copies are available through the Public Service Section, Inquiry Division, Room 1501, Social Security. The first supplement to the printed folder is identified as Release WPB 337.

EQUIPMENT PLANTS INCLUDED IN CONVERSION PLANS

Control of equipment manufacture by the Government is now in its second stage. The first stage methods are continuing. They were primarily based on giving priority or allocation for metal to be used in making equipment. The second stage method deals directly with the equipment maker without regard to his raw material supply. In this second stage the Government undertakes to have metal-working shops, which have built equipment, change over to the making of needed metal parts for munitions.

A recent episode shows clearly the way in which this new effort is being made. In this case, representatives of the industrial machinery division of WPB called on manufacturers of equipment for packaging, and said the plant would be closed within three months if it was not converted. Apparently no effort was made to cushion the blow.

The effect of this situation is likely to be felt within the next thirty days generally. Many shops are going to be forced to make very radical changes in their shop plans. Much of the shift will be altogether voluntary, inspired by patriotic motives. Some of it will come only as a result of the terrorism technic.

CHEMICAL ENGINEERS REQUIRED FOR GOVERNMENT WORK

In an effort to meet the increasing need for scientifically trained men and women, the Civil Service Commission has reannounced, with modified requirements, its examinations for chemical engineer, physicist, and chemist. The salaries in each of these three fields range from $2,600 to $5,600 a year. In chemical engineering the Commission has adequate employment lists in some branches. However, there is a shortage of qualified people in plant layout, equipment design, market analysis, chemical economics, heavy chemicals, plastics, rubber, agricultural by-products, and strategic materials. Applicants may now substitute college teaching in chemical engineering or chemistry for part of the prescribed experience. Applicants will not be required to report for examination but will be rated according to their education and experience relative to the duties of the positions applied for.

News from Washington

WASHINGTON NEWS BUREAU, McGRAW-HILL PUBLISHING CO.

CONFUSION in technical planning greatly increased during February. The situation was so bad that one very responsible reporter stated "The testimony . . . disclosed that nowhere in the government is there a central control for dealing with the rubber situation." This was a fair conclusion from the testimony by Jesse Jones before the House of Representatives committee which undertook to find out what was the matter with the rubber plans.

Despite the confusion, and inability to get action on several important projects, great promises continued to come from certain high officials. Not content with earlier promises of 400,000 tons per year of synthetic rubber capacity by June 1943 one official raised the "ante" to 600,000 tons, apparently forecast by the end of 1943. It is apparent that this kind of simultaneous bragging and bogging down will continue until someone takes definite charge of these technical plans. Now the responsibility and authority are not sufficiently centralized and constantly Army, RFC, and WPB executives pass the responsibility around and around.

The authority of Donald Nelson is probably adequate; but no one man can attend to the multitude of technical details like this while simultaneously engaged in political, international, and administrative conferences for the equivalent of twice the normal working hours each week. Those seeking action, and these are in the vast majority through all agencies, are hoping for clarification of the lines of authority. This may have come about, at least for rubber, even before this issue of *Chem & Met.* appears. But the same situation on other lesser problems is likely for some time to continue to plague the representatives of process industry as they attempt to deal effectively with Washington.

Plant Conversion

All kinds of industry must undergo conversion from anything which it is doing not of a military nature to take on military work. The only exceptions are those plants which are making something so very vital for civilian use that they cannot be spared even in the present emergency. It is almost impossible to over-emphasize the effort which will be made by the Government in urging this conversion.

Many makers of chemicals will shift radically under this program. For example, alcohol manufacture from corn and wheat will be insisted on where it is not physically impossible. The fact that it is troublesome, costly, and difficult will make no difference. The full force of this kind of change has not yet been realized by most chemical enterprise. Nor have the alcohol makers yet awakened to the fact that they *must* proof-up weak alcohol received from small whiskey distilleries and make 95 percent pure alcohol from it. No excuses are going to be accepted. The claim that this is "technically impractical" is pushed aside as unimportant.

Chemical executives will do well to make their shifts voluntarily *and soon*, in the opinion of well-informed Washington. Otherwise those "non-essential" businesses will be ruthlessly handled. They may even lose their power and fuel; or their labor may be taken away from them if needed elsewhere. The motto in Washington is "This is War."

Production Programs

The objective of chemical manufacture is unbelievably higher than it was thirty days ago. Requirements for domestic tin capacity have been tripled and the government-owned smelter now under construction in Texas will have a potential capacity of 52,000 tons instead of the 18,000 tons originally planned. The project has been given top priority rating for obtaining all needed materials.

W. L. Batt, head of the materials division of the War Production Board has announced a revised program for aluminum production which will step the annual output up to 2,100,000,000 pounds and imports from Canada will swell total available supply to 2,580,000,000 pounds. He stated that the program consisted of four parts: the initial program calling for 850,000,000 pounds; the first expansion program of 640,000,000 pounds which is now virtually complete; the second expansion program of 640,000,000 pounds, now underway; imports from Canada 450,000,000 pounds.

For the second expansion program alone he pointed to the necessity of mining an additional 1,500,000 tons of bauxite; of erecting new plants for making carbon electrodes; of supplying electrolytic plants; of providing facilities for converting part of the aluminum into sheet metal; of constructing extrusion plants, casting facilities, forging plants; of increasing production of cryolite and aluminum fluoride.

In referring to magnesium, Mr. Batt placed 1941 production at 33,000,000 pounds with the present objective calling for an annual output of 725,000,000 pounds. The 400,000,000 pound program now under construction of which 54,000,000 pounds has been completed, consists of 352,000,000 pounds made by electrolysis of magnesium chloride and 48,000,000 by the Hansgirg process. Contracts also have been made with six companies for producing magnesium by the ferrosilicon process with a combined annual capacity of 157,000,000 pounds.

The ammonia requirements have been enlarged for two distinct reasons. More explosives are needed, and much more of the explosive will be ammonium nitrate. Also, to raise necessary sugar and oilseed crops we need huge new supplies of domestic nitrogen fertilizers. We can not count on Chilean nitrate as boat space is so scarce. We must make synthetic ammonia for both food and explosive programs. Incidentally the Government has a terrible time in deciding how it will allocate the inadequate quantities of ammonium sulphate and sodium nitrate between these two ultra-urgent uses.

Inter-Industry Battles

One of the most difficult tasks confronting W.P.B. executives is to referee the controversies between industries. This is an inevitable consequence of extensive shortage of industrial materials. The example of a previous paragraph where explosives and food are competitive for nitrogen supply is only one of many such cases.

Stocks of coconut oil on hand at the beginning of 1942 were small. They probably will be the last available material of this sort for the duration. Quite sharp controversy has been going on as to who would get these stocks. Soap makers argued that they should have all of this scarce material as their usage made available a maximum quantity of glycerine. Obvious also was the fact that this fat was quite urgently wanted in order to maintain the desirable lathering and rinsing characteristics of household soaps. On the other hand, there have developed certain important industrial uses for this type of oil. And certain food products cannot be made of their customary characteristics readily without this type of fat. It was a very difficult matter for W.P.B. to decide how much of the limited supply should go to each applicant.

Comparable controversy continues over the question of sugar allocation for alcohol making. Here enters a political consideration, because corn belt congressmen are very anxious to see established new uses for corn. They press this matter, even though it is now evident that there may be a corn shortage for feed purposes next year. Only lately have the wheat interests discovered that perhaps they can sell some millions of bushels of their surplus for alcohol manufacture.

Industry spokesmen who come to Washington are naturally inclined to magnify the needs, or the desires, of their principals. As a consequence, much of the time of the Chemical Branch of W.P.B. has to be given to investigations to determine what is war need, what is civilian necessity, and what is merely trade advantage or desire. Usually, those best informed on these subjects are connected with one or another party to the controversy. Official decisions are often necessarily made by those who technically are relatively unacquainted with any of the competing projects.

Magnesium Processes

There has been much loose talk in the daily press about new magnesium processes. Some such new technical developments are being utilized for several of the newest contracts being negotiated by Defense Plant Corporation. There is no official announcement regarding details; but it is well known among technical men that pilot scale units have been operating in a number of works during the last year or two.

Definite release has been given of information regarding the new electrolytic process devised by Mathieson Alkali Works, in conjunction with Consolidated Mining and Smelting Co. of Trail, British Columbia. This new process uses magnesium chloride made from dolomite by calcining and subsequent chlorination. The essentially new feature is the modified type of electrolytic cell. It has the very great advantage of producing metal and simultaneously giving chlorine in a recoverable concentration. Thus the process differs from earlier methods in that it furnishes a surplus of chlorine for sale instead of being a chlorine-consuming process, considered over-all.

Most extravagant claims are probably those made by irresponsible news writers for the new methods of reducing magnesia with ferrosilicon. That is not a new idea; but substantial experimentation of recent date has been made. The result is at least one, probably two or three, new technics of great importance which will be incorporated in the plants being erected under contracts negotiated during February and March. The raw material is dolomite.

Fertilizer Projects

All available nitrate of soda (both Chilean and synthetic) is now rationed when made available at all for fertilizer use. And each allotment must be used during the month for the crop and in the area to which it is assigned. Thus diversion of scarce fertilizer from urgently needed crops is prevented.

In allocation of fertilizer nitrogen emphasis is given to urgently needed oilseed and sugar crops which require top dressing and side dressing for good yield. Such crops as soybeans, peanuts, and sugar beets do not require this fertilizer; but cotton and Louisiana cane do require considerable nitrogen. Also the corn grown for feed in Southern States requires generous applications of nitrogen and will probably receive it, lest this feed crop required in the deep South be inadequate.

A complete schedule of price ceilings was fixed by OPA for mixed fertilizer, phosphate, and fertilizer potash. From February 27 for three months these commodities may not be sold at prices higher than were authorized.

The OPA Chemicals Section which has to do with "Agricultural Chemicals" was moved at the end of February to Baltimore. Any chemical enterprise seeking to discuss price of fertilizers, insecticides, fungicides, agricultural lime, and related commodities will deal with Baltimore, no longer with Washington. T. E. Milliman, who was chief of this unit, has resigned. Most of the rest of the personnel in the Washington office has moved to the new location.

Patent Mobilization

For a number of industrial projects, the government has requested a pooling of patents and experience. Those best acquainted with methods and having patents of importance on the manufacture of magnesium, synthetic rubber, and synthetic rubber chemicals have so brought together the bulk of their knowledge.

Actions taken thus far have been voluntary. Officials could have compelled cooperation had this been necessary. Large authority exists for commandeering of patents for war usage. But there appears to have been neither need for drastic action nor special desire to use it.

Late in February it was announced that Senators O'Mahoney, Bone, and LaFollette proposed to submit legislation which would provide for greater government control of patents. The strong anti-monopoly leaning of these legislators indicates that this bill would tend to encourage the destruction of exclusive patent rights. It is not quite clear why any additional legislation is needed, since under his war-time powers, the President certainly could do any needful thing without fear of court injunction. The movement, therefore, appears to be against the patent system fundamentally.

Chemical Miscellany

Re-Organization—Radical shake-up of bureaus and agencies in the Department of Agriculture was made officially effective the last week of February. All of the technical bureaus doing research are consolidated into the Agricultural Research Administration. This will include the personnel and activities formerly in Bureaus of Animal Industry, Dairy Industry, Plant Industry, Agricultural Chemistry and Engineering, Entomology and Plant Quarantine, Home Economics, Office of Experiment Stations, and Beltsville Research Center. It is hoped that many non-technical members of the staff can be transferred to war projects. But most of the technical personnel in the modified grouping will continue on that part of their researches which has immediate war-time objective.

Salary Restrictions—Government officials are considering whether a top limit on salaries for employees of different classes should not be imposed at works owned by the government. It is charged that many such plants pay needlessly high rates of salary simply because these become a part of the "cost" which the government assumes. One proposal, having some serious consideration, is that management officials and others engaged in government-owned plants being operated by private companies could be paid no more at government expense than the salary they would receive if directly on the government payroll. Thus, the general manager of a $15 million project might be limited to $8,000 or $9,000 per year. His subordinates would be correspondingly paid. Those who advocate this program say that a company wishing to pay more should be allowed to do so, but only at its own expense.

New Production Index—The Federal Reserve System has issued a new basic index of industrial production. This is a revision of the calculations of the customary figures given out monthly for the guidance of business management. In a pamphlet, made available late in February, the new index is described and old data are re-calculated on the new base, in many cases back to World War I data.

Petroleum Shortage—Tanker sinkings make certain radical restriction on petroleum usage in many parts of the country. They make probable also the building of the additional Texas to Carolina pipe-line currently urged, and perhaps others. Process industry is going to be compelled to change from petroleum fuel to coal wherever practical, especially to conserve heavy fuel oils. Lighter fuel oils for house heating, limited quantities of gasoline, and a few special fuel products are probably the only ones that will take precedence over petroleum usage on direct war manufacture.

Metal Leaks—Officials believe that some scarce metals like copper are being diverted to unauthorized uses. A plant-to-plant survey is being started to see whether all restrictions are being observed. Severe penalties are promised for violators.

Explosives Licensing—The chief of the Explosives Control Division of the U. S. Bureau of Mines will be C. E. Nighman. He is organizing an elaborate field set-up so that licenses can be taken in almost every county without the necessity of coming to Washington or even going to the state capitals. Anyone wishing even a small amount of explosive or certain explosives-making materials must have a license before he can buy or use these necessary goods.

Hours Worked—Time taken by workmen to change clothes, either on arrival or departure from work, is normally to be included in "hours worked" under Wage-Hour rulings. If a workman is free to wear his work clothing from and to his home, then it becomes optional with him as to whether he changes on the plant premises. Only in that event is the time involved in voluntary clothes-changing *not* a part of the working hours. Whether the workman owns the clothing in which he works, or whether it is furnished by the employer, makes no difference in the determination.

E. C. THOMPSON WILL HEAD DU PONT'S GRASSELLI UNIT

Edward W. Furst, general manager of the Grasselli Chemicals Department of E. I. du Pont de Nemours & Co., will retire April 1, after 49 years of service. Emmet C. Thompson, present assistant general manager, will succeed to the general managership. Clark W. Davis will become assistant general manager.

Mr. Furst joined the Grasselli Chemical Co. in 1893 and was a vice-president, member of the executive committee and board of directors of the Grasselli Chemical Co. when it was acquired by Du Pont in 1928. In January, 1936, he was elected president of the Grasselli Chemical Co. and became department general manager when Grasselli was reorganized as a Du Pont unit.

Following twelve years experience with the Cleveland Cliffs Iron Co. and Harrison Brothers & Co., Mr. Thompson became assistant director of the Du Pont company's miscellaneous manufacturing department in 1919, and later was made manager of the pigment and heavy chemicals division. In 1928, he was elected a vice-president of the Grasselli Chemical Co., residing in Cleveland. He returned to Wilmington as assistant genreal manager upon formation of the Grasselli Department.

Clark W. Davis, who succeeds Mr. Thompson, has been manager of the military explosives division of the Du Pont company.

"COMPARABLE PRICES" DEFINED FOR FATS AND OILS

Control of the prices of fats and oils by the Government requires that "the comparable price for any such commodity shall be determined and used by the Secretary (of Agriculture)" when dealing with certain domestic agricultural products. This is done when the production or consumption of a commodity has so changed in extent or character since the 1910-1914 base period as to result in a price out of line with parity prices for basic commodities.

The method of determination of comparable prices is explained in the following way: The average price for each commodity in the period August 1934 to July 1939 is divided by two factors: (1) The average percentage ratio of prices for the five basic agricultural commodities to their parity prices in that period. (2) The average index number of prices paid by farmers for commodities purchased, including interest and tax payments (1910-1914 = 1.00).

R. E. McCONNELL HEADS GENERAL ANILINE & FILM CORP.

On March 10, Secretary of the Treasury Morgenthau appointed Robert E. McConnell, Robert E. Wilson, A. E. Marshall, and George Moffet to serve as managing directors of General Aniline & Film Corp. In February the Treasury Department took title to 97 percent of the stock of the corporation which had been registered in the name of foreign nationals. Mr. McConnell will serve as president and chairman of the board. He is chairman of the Engineers Defense Board and consulting engineer to the War Production Board. Robert E. Wilson is president of Pan American Petroleum & Transport Co. A. E. Marshall is president of Rumford Chemical Works and a former president of the American Institute of Chemical Engineers. George Moffet is chairman of the board of Corn Products Refining Co. and has been working with the Reconstruction Finance Corp.

NEW PLANT IN ARKANSAS TO PURIFY SOUR GAS

The Girdler Corp. of Louisville is proceeding with the design and erection of a Girbotol plant to purify and dehydrate 25 million cubic feet per day of condensate-separator gas from the McKamie, Arkansas, field for the McKamie Gas Cleaning Co. This is the first purification plant designed to produce a marketable gas from this extremely sour field. The gas, which contains about 4,500 grains of hydrogen sulphide per 100 cubic feet and approximately 5 percent carbon dioxide, will be purified to pass the very sensitive Bureau of Standards test for hydrogen sulphide. Incidental removal of carbon dioxide will increase the heating value of the gas. The dehydration feature has been added to prevent hydrate formation in the transmission system. The plant will be complete including steam and cooling water facilities.

A gasoline recovery plant will be erected along with the purification plant and later it is planned to add another plant to convert the recovered hydrogen sulphide to elemental sulphur, sulphuric acid or some other useful product.

STANDARD OIL OF INDIANA WILL BUILD TOLUENE PLANT

Standard Oil Co. of Indiana has concluded a contract with the government to build and operate a toluene plant in connection with its refinery at Whiting, Ind. Construction will be started as soon as details can be arranged and necessary materials can be obtained. It is anticipated that more than a year will be required to build the plant.

Standard is now negotiating with the government concerning erection of an alkylation and butane isomerization plant at Whiting to increase its output of 100-octane aviation gasoline. Existing facilities are already operating at capacity and are supplying large amounts of aviation gasoline.

CHEMISTS' ADVISORY COUNCIL HAS BEEN DISBANDED

The Chemists' Advisory Council has been disbanded by the board of directors. This decision was forced by the inability to obtain sufficient financial support to continue its services to the unemployed chemists and chemical engineers throughout the country. The Council was an outgrowth of the Committee on Unemployment and Relief for Chemists and Chemical Engineers which was organized during the depression years. At its last meeting the board passed a resolution of appreciation of the untiring, lasting and self-sacrificing services of M. R. Bhagwat who has served as secretary during the entire existence of both organizations.

PYRITES PRODUCTION IN SPAIN AFFECTED BY THE WAR

Special Correspondence

The war, with the consequent submarine blockade in the Atlantic Ocean and Mediterranean Sea, has brought the Spanish pyrites business to a low estate. The writer recently visited Huelva Province for a survey of pyrites production.

Prior to the war there was an organized cartel controlling distribution of the pyrites of Rio Tinto, Cyprus and Germany. This, of course, ceased to function with the advent of war. This situation has been particularly difficult for Rio Tinto, as their copper ores are practically exhausted and the future of their operations in Spain will depend on the mining and selling in export trade of the vast quantities of pyrites remaining in the mains. These pyrites contain small amounts of copper, with small amounts of gold and silver and sometimes a little lead.

Currently operations at Rio Tinto are down to about 30,000 tons monthly. Of this less than 10,000 tons monthly can be sent to the United States. Except for an occasional cargo that goes to England, the bulk of the remainder is burned for sulphuric acid production at the Company plant at Huelva, and this sulphuric acid in turn, is used largely to treat phosphate rock from logrosan at another plant, also at Huelva.

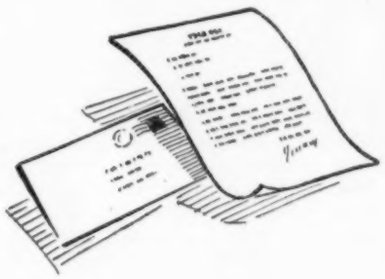
All shipments to the United States are carried necessarily in Spanish ships. I was informed that the Spanish Government has allocated three ships of those controlled by Spain to the service of Rio Tinto exports. Since these ships must secure and load a return cargo for Spain the average round trip consumes from 6 weeks to 60 days.

It is quite possible that an occasional light draft ship of German origin may get to Huelva by traversing territorial waters and pick up a cargo but this can have but little effect on output. Sail shipments out of Huelva to points in Europe are out of the question. The railroads of Spain lost about half of their equipment in the Civil War. The remainder is in bad condition and becoming in worse condition daily. Frequently no trains move because of lack of coal for locomotives.

Pyrites production in Spain in metric tons for the first 8 months of 1941 was as follows: Huelva 242,555, Murcia 3,669, Santander 11,125, Sevilla 22,303. That shown from Santander and Sevilla was largely from the production of zinc concentrates.

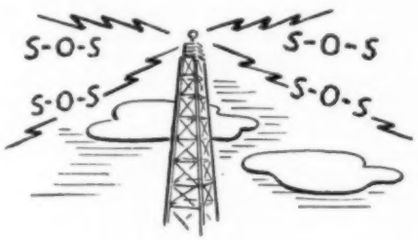
Now the SUBSTITUTE promises to OUT-PERFORM the material it replaced!

The first in a series of actual cases from the files of Monsanto's Technical Service Department which show how skill, experience and ingenuity can solve many of industry's critical wartime problems. For obvious reasons names and any clue which would identify the principals in the case have been omitted.



1. X, a Monsanto customer of long standing, opened his morning mail recently to find his continued business life suddenly threatened.

A certain chemical essential to his manufacturing process had fallen victim to priorities, was no longer available to him. Worse, he had only a slender supply on hand.



2. Now, X might have wired his Congressman or taken the next plane for Washington—but he didn't. And it wouldn't have helped if he had.

Instead, he sent an S. O. S. to Monsanto for technical service—and before his slender supply was exhausted, a new chemical had been found, tested, and put to work in his plant, ***where it fully equalled the old material and now gives promise of doing an even better job!***

3. Obviously not every problem handed to Monsanto Technical Service is so quickly solved—nor so happily. But the very breadth and variety of Monsanto's chemical manufacturing experience often gives its technical men a headstart toward a solution and with so many basic chemicals being drafted for the vital war program—technical service from your supplier often becomes as important as quality and uniformity in the chemicals he supplies!

A WORD ON QUALITY AND UNIFORMITY

Whatever troubles today's shortages may cause and however much they may wreck delivery schedules, there are two essentials you must be *sure* of getting in *every* shipment of chemicals that enters your plant—*quality and uniformity!*

That's why *every* batch of *every* Monsanto chemical is carefully controlled at *every* step in its manufacture . . . and *every* batch is *double-checked* in the control laboratory before it leaves Monsanto's plant for yours. MONSANTO CHEMICAL COMPANY, St. Louis, U. S. A.

MONSANTO CHEMICALS

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"E" for Excellence . . . the pennant denoting the highest service accomplishments in the United States Navy . . . flies with the Naval Ordnance flag over Monsanto. In the words of the Secretary of the Navy, this award has been made to Monsanto "in recognition of your outstanding efforts in the production of ordnance materiel vital to our national defense."

NEED FOR FUEL ECONOMY PRESENTS BRITISH CHEMICAL ENGINEERS WITH NEW PROBLEMS

Special Correspondence

ECONOMY of fuel consumption has never been more important than it is after thirty months of war in Great Britain to-day. Lacking natural resources of mineral oils and gas, the country depends (apart from a modest production of shale oil in Scotland and a not much more significant though lately increased supply of wood fuel and charcoal in various localities) upon the big coal mining industry for the provision of power for industry and transport. To save coal, the Department of Mines has set up a Fuel Efficiency Committee which has now reported that improvements in the operation of industrial fuel-using plants can be expected to reduce the coal consumption by 10,000,000 tons. No less than 4,500,000 tons are to be saved in the generation of steam and power, a similar amount is to come from better utilization of process steam and power, and the remaining 1,000,000 tons will be obtained by reduced transport of coal consequent upon other economies.

This estimate is by no means over-optimistic; private observers have arrived at even larger figures. But it is based on the assumption that systematic efforts for fuel economies are made in all sections of industry, and chemical engineers are to play an important part in the "save coal" drive. To use the words of the Director of Gas Supply, a government official who occupies a forward place in this field, "the chemist should be to the furnace-user a service department available to give advice and criticism, but without functioning as the furnace operator." The task of the chemical engineer is the greater because the problem facing British industry is not just to save fuel but to consume fuel in the form which is the most advantageous under general economic considerations. With a growing demand for all kinds of coal-tar products, for coke and manufactured fuels there is obviously an increasing outlet for gas. The tendency in British industry is certainly towards processed fuels and away from raw coal.

The gas industry did not find it easy to cope with an increasing demand under war conditions. Yet the problem of operation in and after air raids has been solved as far as that is possible. It has been discovered that sudden stoppages of batteries due to air raid warnings tended to result in increased formation of roof carbon, increased free carbon in the tar, increased naphthalene and pitch contents in the tar, and decreased toluene contents in the crude benzol. All these undesirable effects were due to increasing cracking of vapors in the space between the top of the charge and the roof of the oven which resulted from an increase in roof temperature. A solution of these difficulties may be found by use of smaller batteries. The usual plant containing between 20 and 40 ovens has shown limited flexibility. But the necessary balance between production and consumption in gasworks during times of irregular activity can, by simpler means, be brought about if the rate of coke extraction is altered. To what extent this can be done depends upon type and grading of coal, calorific value of the gas, and the design of the retort. In practice a reduction in the output of gas by 25-30 percent has been obtained within twelve hours, and the resumption of full throughput was achieved within twenty-four hours. While these remarks refer to continuous vertical retorts, in intermittent vertical chambers surplus coal gas has been used as fuel gas, with the result of a 22 percent output reduction. It was found that up to 50 percent of the total fuel requirements can be supplied by gas without operational difficulties. A simpler method, however, in operations with continuous vertical retorts was a change-over from a high-class to a lower grade of coal which resulted in an output reduction by 20 percent. These examples are interesting not only because they show that gasholders are not the only means to absorb surplus production of gas in an emergency, but because increased attention must be paid to possibilities for utilization of special grades of coal. The gas industry can obviously help to solve this problem. Experiments by the Eire Emergency Scientific Research Bureau at Kilkenny have, it may be mentioned, shown that a mixture of peat and coal can be used to make town gas. Up to 40 percent by weight of turf do not cause any special difficulty.

Gasworks and coke producers are still asked to do all they can to increase the output of valuable byproducts. The allocation of the supplies of coal-tar available in the industrial regions of Britain calls for constant attention, and the Controller's field of activity continues to grow. An official control scheme is expected shortly for cresylic acid; pressure for supplies on the side of home consumers has had the result that export licenses are granted less freely. A control order for crude carbolic acid has been avoided by voluntary arrangements between the producers of crude carbolic acid and the makers of phenol; consumers of the latter product have been asked for utmost economy. A National Creosote Committee has been formed to arrange, in conjunction with the Controller, for distribution of the product for hydrogenation, timber preserving and other uses. In this connection it is understood that negotiations are nearing completion for the first batch of contracts with the Petroleum Board for indigenous fuel oils to a total of probably 500,000 tons.

The events in the Far East and their effect on rubber supplies have been felt by British chemical firms first by a decline in the demand for products used in rubber manufacturing due to the restrictions on civilian rubber goods. There is little hope at present for the establishment of a rubber substitution industry on a really large scale in Great Britain for which indeed prospects appear rather bleak. England lacks petroleum, one of the chief raw materials; the production of calcium carbide, another raw material for synthetic rubber, is in any case inadequate; and the valuable coal products used by the German industry are already utilized here for important war work. The necessary machinery is not available, nor could it be expected in view of the great demand for similar apparatus from makers of fine chemicals that it could be speedily provided. And there is finally a shortage of the necessary skilled labor. For all these reasons it seems to be intended to rely primarily on substitute products with rubber-like properties rather than on substitutes of rubber-like chemical structure. Reclamation of rubber must also meet with difficulties, as in spite of a large accumulation of old rubber no attempt has been made to erect a reclamation industry. One proposal therefore provides for shipment of old rubber to U. S. factories specializing in reclaim.

New arrangements for the distribution of rosin, turpentine and pine oil from the United States have now been made by the Ministry of Supply acting through the United Kingdom Naval Stores Association. Special interest has been aroused by the offer of considerable quantities of pine oil, and dyers in particular hope to develop new outlets for the material in solutions of spirit soluble dyestuffs which can be used in the production of dry dyeings. The excellent wetting properties of pine oil and its ability to form stable emulsions with water, soap and the usual agents employed by British textile manufacturers have been acknowledged. Pine tar is still being used in large quantities on British ships for calking decks, tarring rope, dressing jute covers, etc. There is a possibility that certain quantities of the material will in future be obtained from Canada.

The paper industry is one of the oldest buyers of chemical products, but in Great Britain at any rate it has not received much attention from chemical manufacturers until lately. The British paper industry can play an important part in saving shipping space—a fact which has been acknowledged by the authorities when they invited lumbermen from North America to apply their skill to the clearing of British woods. Some paper mills have changed over to new raw materials; thus the esparto mills now use straw. Mills with plants capable of processing rags will also find full employment, but others may have to close down. A voluntary agreement for "concentration" in the paper industry has now been reached which may eventually result in the interrup-

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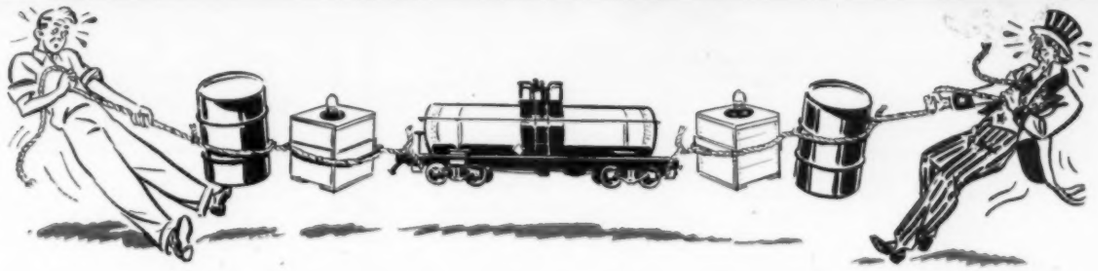

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Immediate return of these containers will expedite *your* deliveries of chemicals, as well as those of other manufacturers producing essential materials. It will, at the same time, reduce the necessity for building new shipping equipment to be used in place of that which may be standing idle in the field.

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With greater responsibility being put on shipping containers by today's high speed shipping and handling, the extra strength and durability of Bemis Waterproof Bags become more and more important. Here are containers built to stand rough handling . . . to take knocks, bumps, and the strains of stacking . . . to deliver their contents safely.

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WATERPROOF DEPARTMENT

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tion of work in part of the fifty mills which have not qualified for "nucleus" status.

The need to save paper has resulted in revolutionary changes in packing, but shortages of other materials are also felt in this field. To save metal, British makers of pharmaceutical and cosmetic articles make use of various substitutes. One of the tubes for face and shaving creams, toothpaste, etc. is made of a neat fabric cover, such as artificial silk, lined with a plastic. Synthetic resins supply the cap, collar and nozzle too. The rayon-plastic body of the tube is fixed between collar and nozzle on the one end and sealed on the other by the usual strip of metal. Fabricating costs are lower, the appearance is fully as attractive as that of the traditional tin or aluminium tube. Another plastic development that is new for the British market are steam-pressure gages with plastic casings in standard sizes of 4, 7 and 10 in. diameter for use on wall panels in steam boiler plant, electric power station and other industrial works.

American makers of vitamin B have helped to provide the material for the fortification of white bread in the British Isles. Originally it was thought that one private firm in England would be able to supply all requirements, but at present only 25 percent of all white bread is being fortified, and when the system is extended in a few weeks time to the North-west of England the quota will still be below 50 percent of the total consumption. The Ministry of Food has decided to acquire, equip and finance two new factories for the manufacture of aneurin, but it is not expected that they will be in production for eighteen months. In the meantime the public remains highly critical of all efforts to "doctor" its bread, and if, as intended, the consumption of wholemeal bread is increased, the problem will solve itself without recourse to chemical food supplements. Not even the rose hip syrup which is issued free of charge to children at welfare centres has met with a kind reception. Conservative habits and prejudice against things that are "given away" explain the lack of success of this part of British food policy.

MATHIESON WINS PATENT SUIT ON USE OF OYSTER SHELLS

On Feb. 9, the Supreme Court of the United States refused to review the decision of the Circuit Court of Appeals for the Fifth Circuit in the case of W. D. Haden Co. vs. The Mathieson Alkali Works, Inc. The Haden company charged infringement of its patent on a process for burning oyster shells in rotary kilns for the production of lime. The hearings developed that crushing of the shell before calcining is an essential part of the process covered by the patent and it was shown that the Mathieson company merely washes shells dredged from reefs and subjects them to no crushing treatment before calcining in rotary kilns of special design.

CHEMISTRY PLAYS IMPORTANT ROLE IN AGRICULTURAL PROGRAM FOR SOUTHEASTERN EUROPE

EDITOR'S NOTE: *Cut off from direct correspondence with all except a few foreign sources in neutral countries, these notes interpret recent developments in continental Europe as reported in a wide range of publications and official documents received in the United States prior to our declaration of war. These monthly letters, prepared in this country, will be continued only so long as pertinent material of interest to American chemical industry is available for our comment and interpretation.*

AN increase of 50 percent in agricultural yield per acre in southeastern Europe through using German experience, chemicals, machines, and seeds is the goal set by the Reich in its attempt to make the European continent self-sufficient. The German government is sending modern machinery and fertilizers and insecticides and is ordering what crops are to be planted in the Balkans, Poland, and other areas where the "new order" is already being put into effect to consolidate Nazi war gains and insure future supplies.

Chemistry is playing a larger role than ever before in the Reich agricultural program, both in supplying artificial fertilizers, treating seeds, and also in food industries processing sugar beets, starch, alcohol, quick-refrigeration and dehydration products. The doubling of the crop yield in Germany proper during the past half century is attributed approximately 50 percent to the increased use of mineral fertilizers, 30 percent to the planting of better seeds, and 20 percent to improved methods of cultivation and other factors, according to Dr. F. Frowein in an address to the Chemical Society of the Institute of Technology in Brünn, Moravia. He stated that at present less than one percent of the total arable land in the Reich is not tilled, whereas a century ago in the same areas over one-third of the arable land lay fallow from year to year.

The most serious agricultural deficiences are in rapeseed, root crops, hemp and flax, garden vegetables, and milk. The acreage planted in rapeseed, which supplies a high percentage of oil and oilcake for cattle feed, increased from 12,000 acres in 1932 to 494,000 acres in 1940, and the planting of an additional 247,000 acres of oil-seeds in the Reich was ordered for the season of 1941-2. Experiments with a new "winter and shatterproof" rapeseed are claimed to be successful. Hard winters have killed off large numbers of rapeseed plants in the cold European climate, and another 15 to 20 percent of the grain has been lost by pods shattering before or during harvesting.

The production of oil-seeds, including soya beans, lupine, and sunflowers, has been pushed in Danubian areas, especially Rumania, while cultivation of rapeseed has been made compulsory on the larger farms in Bohemia and Moravia for the 1941-2 season, with the seed being furnished by the Government Grain Monopoly. Safflower (carthamus tinctorius), a hardy thistle-like oil-bearing plant of Asiatic origin which can be cultivated on poor soils, has been tested with good results in experimental farms in Thüringen, and may soon be planted on a large scale on marginal lands.

Root crops are important for cattle feeding and food processing industries. Germany's production of sugar beets, together with that of occupied territories, is sufficient to take care of essential needs. Sugar beet plantings were raised 20 percent higher in the second than in the first year of the war, mainly to supply industrial needs. Sugar beets are used not only for sugar manufacture but increasingly for cattle feed and for production of industrial alcohol, and when other foods are short, for human consumption.

The raw materials for industrial alcohol production have varied considerably during the past ten years according to the availability of supplies of sugar beets, grains, potatoes, and more recently of cellulose waste liquors and wood sugarization residues. Alcohol production of the Government Alcohol Monopoly reached a peak of 4,158,100 hectoliters in 1938.

One of the chief uses of alcohol in Germany has been for admixture with gasoline and other motor fuels. Alcohol used for this purpose alone is usually equivalent to the combined total used in production of beverages, solvents, denatured alcohol, acetic acid, and in the perfume and cosmetics industry. A curtailment in the latter field is indicated by a recent decree forbidding the use of propyl alcohol and isopropyl alcohol for the manufacture of hair tonics and face lotions.

In the past few years the raw material basis of the alcohol industry has shifted considerably. Instead of using potatoes, grains, and sugar beets which could also be used for human food, cellulose waste liquors resulting from expanded cellulose and synthetic fiber production have been increasingly utilized. In 1937 to cut down alcohol consumption the ratio of admixture of ethyl alcohol to motor fuels was reduced, but this was later increased again. At present, cellulose waste liquor is the chief source for monopoly distilleries, and the production of methanol probably has risen further owing to the development of the wood sugarization industry.

Wood sugarization residues from the Bergius-Rheinau and Scholler-Tornesch processes may in the future supply the raw material basis for a large scale industry like that for coal tars. In 1941 about 500,000 tons of wood, chiefly beech, were used in the Reich for distillation purposes. Besides yield-

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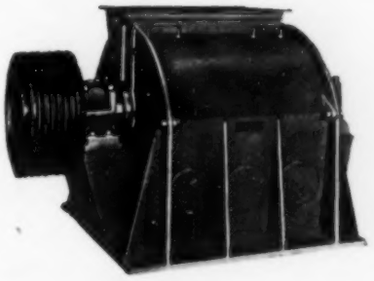

Especially if the material or product involved is essential to our Victory Program.

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The patented screen and knife arrangement in Sprout-Waldron Rotary Knife Cutters reduces excessive fines and power requirements to a minimum.

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We are speaking as Americans, to Americans, with the customary frankness that marks the American way of life. You are probably aware that the name Seitz is of German origin and might lead to misunderstanding. To make it clearly evident that our entire personnel and all our efforts are wholly devoted to the patriotic service of our country, we are now operating as

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AMERICAN SEITZ FILTER CORPORATION

As our company becomes absorbed in defense work, civilian requirements will be increasingly hard to meet, but we will, as in the past, do everything possible to help you. The same officers are eager to serve you —the same plant and sales setup continue.

You can realize that it is no easy matter for a firm to change its corporate name. But you can make that task, in these times, just a little easier, by noting the new name—REPUBLIC FILTERS, Inc.—in your records . . . to avoid delay and confusion. We need not tell you how greatly we appreciate your making this change immediately.

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ing charcoal, wood vinegar, and tar oils, the wood was used to produce methyl alcohol as well as smaller amounts of wood sugar. Since the beet sugar industry, founded by Achard in 1802, is able to supply domestic sugar, the wood sugar product is used chiefly for a protein-rich fodder.

To increase the available supply of cellulose the Reich has recently concluded large scale trade agreements with Scandinavian countries. On January 23 in Berlin a commission was set up for mutual consultation on forestry and forest-product problems between the Swedish, Danish, Finnish, and German governments, and provisions were made for other governments who might join at a later date. The commission is to handle questions of a scientific, technical, and economic nature within the forest industries and to investigate possibilities for trade.

Deciduous and evergreen stands are being enlarged in the Reich where possible. The government decreed recently that in preliminary open-pit mining operations the mine must save the top soil. It is used to cover slag dumps, and compost is added to increase the fertility. Black alders, which grow on sandy soil without sub-soil irrigation, are being planted on the leveled slag piles. Old open mines and quarries are also to be stocked with fish under a program similar to that by which the state railway has already stocked its quarries near Munich.

Mineral production in occupied territories is being organized by Reich technicians to utilize these new sources as speedily as possible. The Reich lacks essential minerals such as tungsten, tin, molybdenum, asbestos, and copper. The shortage of copper has made it increasingly difficult to supply sufficient Bordeaux mixture (copper sulphate, lime, and water) for fungus control in Germany and other wine-producing areas of Europe. The sale of copper sulphate is strictly controlled, and Italy, for instance, is having great difficulty supplying only a fraction of the 25,000 to 30,000 tons copper needed every year for its wine culture.

Copper sulphate is also used normally for wood preserving. In the wood-fireproofing as well as in the fertilizer field the deficiency of phosphates is most noticeable. Western Europe, rich in potash, is very short of natural phosphate deposits. Since it is a heavy fertilizer-using area, it is dependent upon imports of phosphate rock and phosphate basic slag resulting from processing phosphatic irons in the basic Bessemer and basic open-hearth steel furnaces.

A joint commission representing the chemical industry and the Bureau of Standards has decreed that phosphate supplies must be stretched by admixture, of ammonium sulphate with ammonium phosphate for manufacturing fireproofing materials. In standardizing wood-fireproofing products, this commission specifies that in the

future, two coats of fireproofing materials have to protect wood surfaces so that they can withstand temperatures up to 400 deg. C. The Reich chemical office is recommending the use of aluminum silicate and salicylic acid for insect and fungus protection and is allowing up to 40 percent ammonium phosphate to be used in fireproofing agents, requiring that the remainder be ammonium sulphate. It is left to individual producers to determine whether they wish to use mono-, di-, or sesqui-phosphate. The fireproofing materials are marketed under the firm names of manufacturers but must bear one of the two standard designations "FM-1" or FM-2" (Feuerschutz-Mittel).

As to other mineral shortages, the Reich's deficiencies of manganese ore are claimed to have been partly offset by the German capture of the Nikopol manganese mines in the Ukraine, with an annual capacity of 1,200,000 metric tons. In 1940, areas now controlled by Germany supplied 37.5 percent of the worlds manganese output.

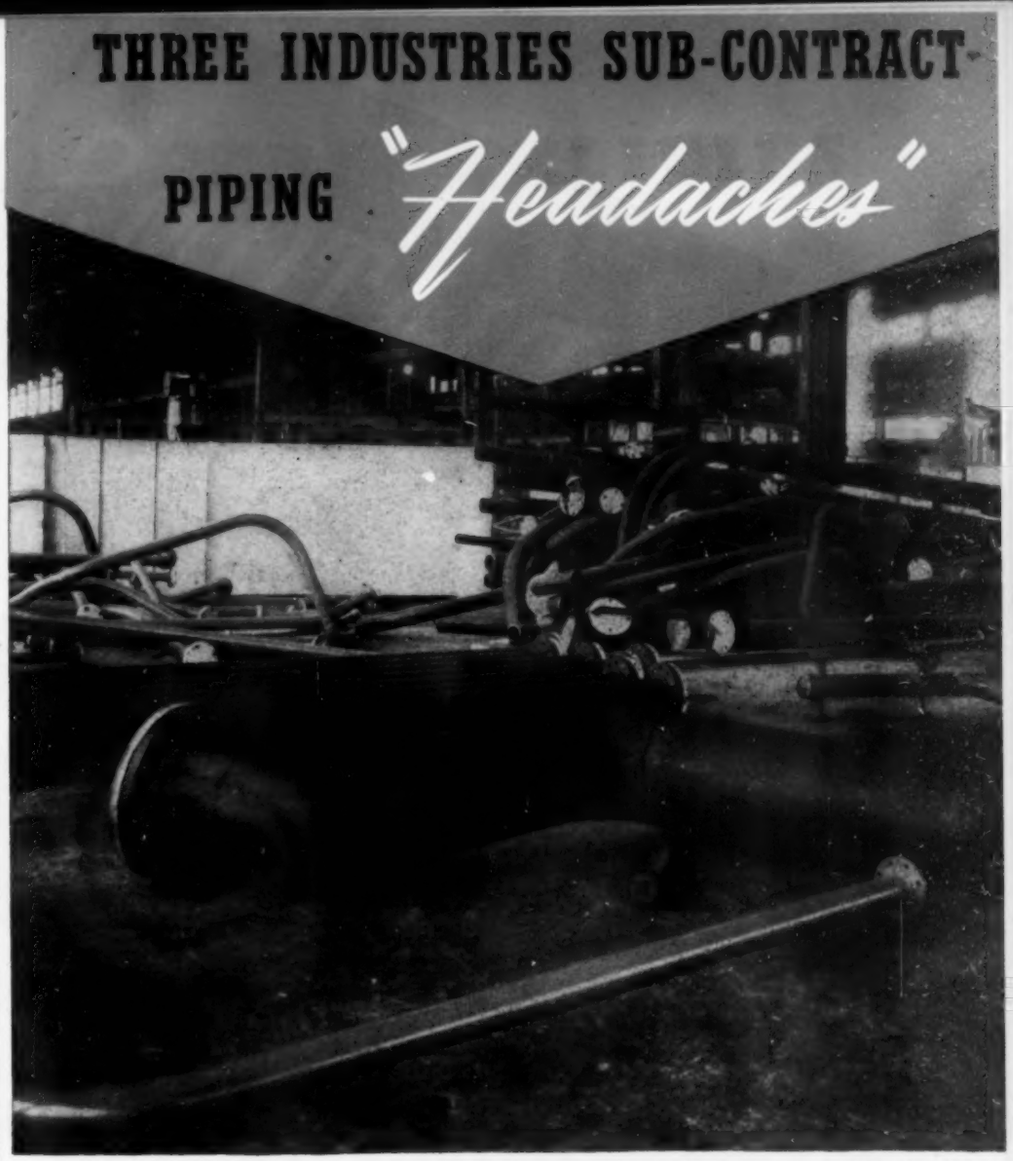
Vanadium, of which Germany is said to have adequate supplies, is being studied by the industries concerned and the Aachen Institute of Technology as a possible substitute for molybdenum and chrome, even though vanadium is more expensive. Chromite is produced only in small quantities in the Balkans. It figured prominently in the recently-concluded German-Turkish trade agreement. The Aachen institute reports that vanadium increases hardness in middle temperature castings and is fairly good, but it admits that results were not too satisfactory for other substitute uses. The shortage of ferro-alloys in general is indicated by the fact that production of castings containing a number of alloys is on the decline in the Reich, and in many cases, where formerly used, no alloys are used at all.

Tantalum, a minor metal of the vanadium family, is being used increasingly in plants handling acids, especially hydrochloric. It is being manufactured in Europe by Siemens and Halske, Berlin electric firm, in various shapes such as sheets, bands, wires, seamless tubes, rings, etc.

Germany and Austria have a considerable deficit in copper production in spite of strenuous efforts to develop low grade output of the Mansfeld mines at a cost estimated to be over double the world price. Consumption is believed to average 300,000 tons a year, with production hardly reaching 40,000 tons in 1940. The Reich has improved its position in the meantime through seizing stocks of occupied countries and through acquiring control of the formerly French-owned Bor mines in Yugoslavia. Moderate-sized imports of copper are also possible from Spain, Norway, and Sweden. Nevertheless, every effort is still being made in Germany to replace copper with plastics, aluminum, and other metals wherever possible.

THREE INDUSTRIES SUB-CONTRACT-

PIPING "Headaches"



UPPER LEFT, process piping for oil refinery CENTER, mine shaft pip
RIGHT, important links of a steam power installation

THREE different industries – a power plant, an oil refinery and a mining operation – escaped the "headaches" of new piping installation when they *sub-contracted* the prefabrication to Grinnell!

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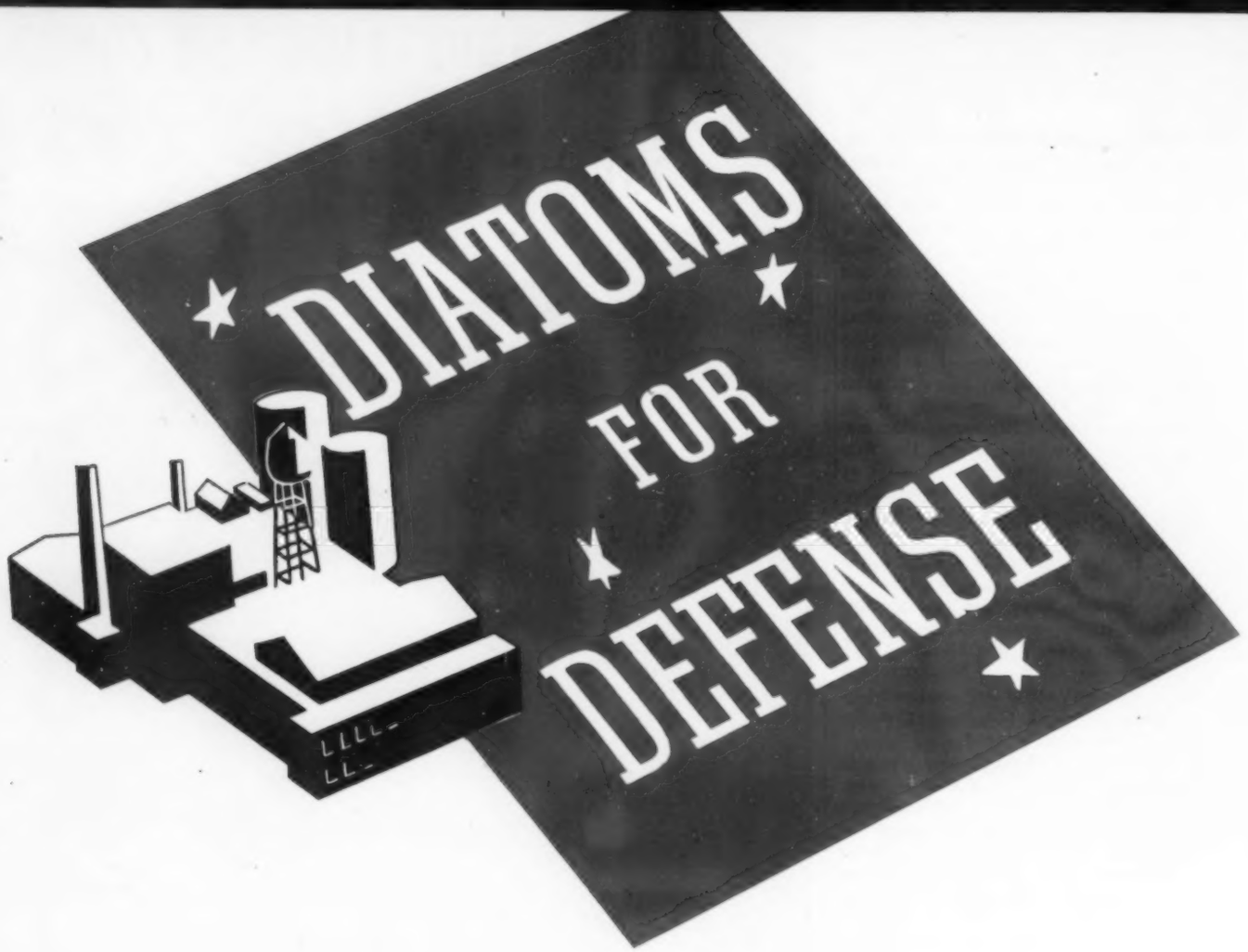

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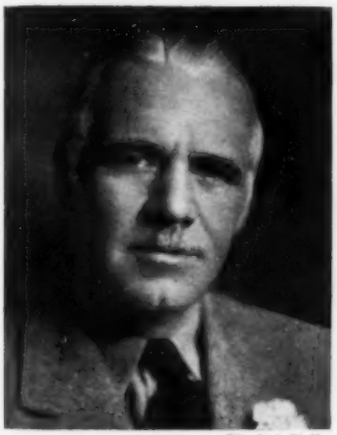
Osborne Bezanson



Blank & Stoller

A. M. Pitcher

✦ Osborne Bezanson, production manager of the Merrimac Division of Monsanto Chemical Co., with headquarters at Everett, Mass., has been relieved from those duties and assigned to executive supervision of the two new government owned plants which Monsanta will operate. Although both plants will be located in Texas, Mr. Bezanson will make his headquarters at St. Louis.

A. L. Gardner will succeed Mr. Osborne Bezanson as production manager of the Merrimac Division of Monsanto Chemical Co. at Everett, Mass. Mr. Gardner has been Everett plant manager.

David L. Eynon, Jr., who has been operating superintendent of the contact sulphuric acid unit at the Everett, Mass., plant of Monsanto Chemical Co., and Dr. Charles S. Comstock, who has been in the Merrimac Division research laboratories at Everett, have been relieved of those responsibilities in order to be members of Mr. Bezanson's staff at St. Louis..

George Odom, who has been superintendent of the alum department of the Merrimac Division of Monsanto, has been promoted to superintendent of the East works, and D. H. Parshley, who has been superintendent of the H-Acid department, has been promoted to superintendent of the West works.

✦ Marston T. Bogert, in addition to his regular university duties as emeritus professor of organic chemistry in residenee at Columbia University, has become connected also with Ralph L. Evans Associates to aid them in studying the many chemical problems constantly arising in the progress and development of their business and research, particularly those due to the present emergency, to the end that the present plant capacity, physical equipment and other resources of this organization may be devoted increasingly to their war time needs, and to work on those problems which will confront them later in the post war adjustment period, because of anticipated changes in chemical needs of our future way of living.

✦ Charles V. Seiler has joined the research and development staff of Bakelite Corp., Bloomfield, N. J. Mr. Seiler recently received his science degree at Brooklyn College.

✦ A. M. PITCHER, formerly vice president of the Westvaco Chlorine Products Co., New York, N. Y., has joined the H. K. Ferguson Co., industrial engineers and builders of Cleveland and New York. Mr. Pitcher will act as consulting chemical engineer. He served for 20 years as vice president in charge of production for Westvaco and was responsible for production of plants at Charleston, W. Va., Carteret, N. J., and Newark, Calif. Prior to that he was with Chemical Warfare Service, assigned to Edgewood Arsenal, Baltimore, Md., during 1918-19, and he was with E. I. duPont de Nemours & Co. from 1911-17. He was graduated from Swarthmore College in 1911. Mr. Pitcher will make his headquarters in the Cleveland office of the Ferguson organization.

✦ HAROLD H. EVERETT has recently been transferred by Foxboro Co. from New York to Foxboro, Mass., to become assistant purchasing agent.

✦ William E. Keppler, a senior student of Pratt Institute, Brooklyn, N. Y., is the winner of the prize granted by W. W. Winship of the Thermal Syndicate, Ltd., New York, N. Y. The prize covers the annual dues to the Electrochemical Society. Mr. Keppler has been specializing in chemical engineering.

✦ Hugh S. Taylor, chairman of the Department of Chemistry at Princeton University, is the recipient of the Longstaff Medal of the Chemical Society of London. The medal is conferred every three years upon a fellow of the society "who, in the opinion of the council, has done the most to promote the science of chemistry by research."

✦ Frank T. Bumbaugh has been appointed assistant manager of sales, alloy division, of the Carnegie-Illinois Steel Corp. He was formerly metallurgical engineer in the bar and semi-finished products division of the company. He will make his headquarters at Chicago.

✦ Jerome L. Boyer has been appointed director of technical sales of Newport Industries, Inc., succeeding E. V. Romaine. Mr. Boyer was graduated from the Massachusetts Institute of Technology in the class of 1922. He has been on the technology staff of Newport Industries and associated companies since 1929. He was formerly with Hollingsworth and Vose Paper Co. in their chemical department and with Simplex Wire & Cable Co. Later he was with Tidewater Oil Co. in the research department at Bayonne, N. J.

✦ Edwin L. Dennis, chief combustion engineer of the Coppus Engineering Corp., Worcester, Mass., has asked to be relieved of his duties as instructor at Louisiana State University, Baton Rouge, La., in order to devote his full energies to the increasingly vital problem of efficient combustion in industrial plants.

✦ Albert R. Mumford has been appointed to the research department of Combustion Engineering Co., New York, N. Y. A graduate of Massachusetts Institute of Technology, class of 1918, Mr. Mumford's background in fuels, combustion and steam generation covers four years as assistant fuels engineer of the U. S. Bureau of Mines, over 15 years as research and design engineer with the New York Steam Corp. and from October, 1938, to February, 1942, as assistant director of research of the Consolidated Edison Co. of New York.

✦ Harry E. Smith, general manager of the Manhattan Rubber Mfg. Division of Raybestos-Manhattan, Inc., was elected a member of the board of directors of the Rubber Manufacturers Association, at a meeting of the board on Jan. 20. Mr. Smith replaces Mr. F. L. Curtis, former general manager of the Manhattan Division.

Homestead Lever-Seald Valves *always* work! Conditions that cause ordinary valves to "stick" . . . viscous fluids, temperature and pressure extremes, infrequent operation, etc. . . . *cannot* make *Homesteads* inoperative. The most stubborn "seizure" yields instantly to hand-applied movement of the lower lever, followed by full opening or closing of the valve with an easy, quarter-turn of the upper handle. This never-failing operation is only one of numerous advantages which include a positive, leakless seal without lubrication; seating surfaces protected in all positions; streamline flow that minimizes pressure drop; and longer, lowest - cost - per - year service. Sizes, styles, metals and alloys to suit most every Process-Industry requirement are available. Put your service problems up to Homestead engineers for sure solution.

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HOMESTEAD VALVES

✦ Julian J. Frey has been appointed director of the technical service department of the Ethyl Gasoline Corp. into which are placed all the technical service activities of the corporation. Mr. Frey has been manager of the company's technical sales division since 1930.

Charles L. Wiswall

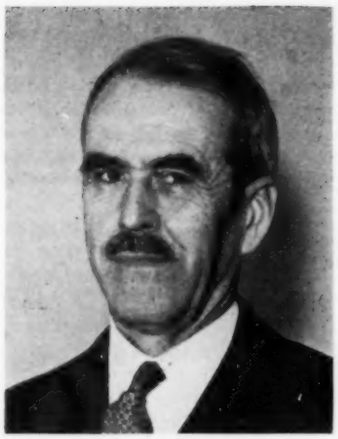
✦ Charles L. Wiswall has been made assistant general manager of the Photo Products Department of E. I. du Pont de Nemours & Co. Samuel C. Harris is now director of sales of the R. & H. Chemicals Department of E. I. du Pont de Nemours & Co. He assumed his new duties Feb. 15.

✦ E. J. Bradbury, a graduate of Purdue University, has accepted a position with Merck & Co., Rahway, N. J.

✦ John J. Linker has been appointed chief engineer of the Crane Packing Co., Chicago. He has been placed in charge of production and engineering development of the company's line of metallic and fabric packings and mechanical pump seals. Mr. Linker, a graduate of the University of North Carolina and Drexel Institute, brings an extensive construction, industrial and marine experience to his new post, having acted in similar capacity for the Flintkote Corp., prior to which he served with Stone & Webster Engineering Corp.

✦ ELMER J. WEIS has been elevated to the vice presidency of Pacific Pump Works. Because of the need for top-ranking engineers at this time, Mr. Weis will retain an active interest in the company's engineering developments in addition to handling his new responsibilities. He has been with Pacific Pump Works since its organization in 1923.

✦ E. A. HARPER, formerly connected with the North Carolina Pulp Co., is now associated with the Brunswick Pulp & Paper Co., Brunswick, Ga., as technical director.



Frank S. MacGregor

✦ FRANK S. MACGREGOR, director of Priorities Division of E. I. du Pont de Nemours & Co. has replaced Milton Kutz as assistant general manager of the R. & H. Chemicals Department. Mr. Kutz has been assistant general manager since 1933. He has been away for several months due to illness and upon his return will assume his new duties as sales advisor and assistant to the general manager of the department.

✦ EDWIN H. BROWN has been elected a vice president of Allis-Chalmers Mfg. Co., in charge of engineering and development.

✦ NICHOLAS L. KALMAN, formerly with Arthur D. Little, Inc., has joined the staff of Ridbo Laboratories as director of organic research.

IN THE ARMED FORCES

✦ ROBERT W. ROWDEN, formerly instructor at the Little Rock, Ark., Junior College, is now a second lieutenant in the armed forces. He is stationed at Fort Monmouth, N. J.

✦ FRANK E. DOLIAN of Commercial Solvents Corp., Terre Haute, Ind., has reported for active duty as a lieutenant with the U. S. Army.

✦ WILLIAM M. COY has been commissioned lieutenant in the Naval Reserve and is now on active duty at the Naval Aircraft factory in Pennsylvania where he is serving as superintendent of schedules.

✦ RICHARD PENFIELD has left the Celanese Corp. to enter active service in the army. Colonel Penfield has been assigned chief of Plants Division at Edgewood Arsenal, Md.

✦ HENRY BAKER, JR., has reported for duty as captain, Chemical Warfare Service, U. S. Army. He is in the office of the chief of the service at Washington, D. C. Captain Baker served seven years as commissioner of conciliation of the United States Conciliation Service and for the past year as the Department of Labor Liaison Officer to OPM

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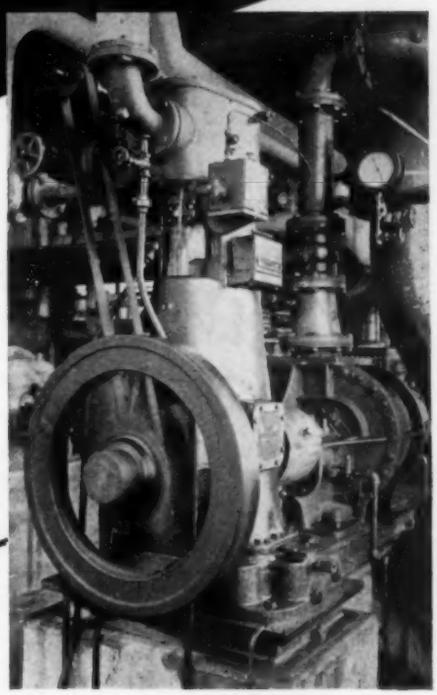

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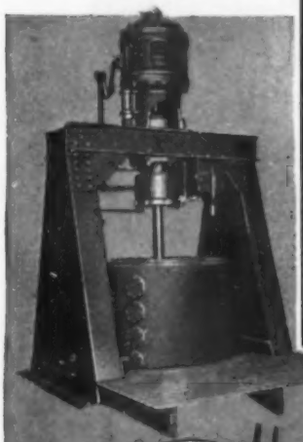

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✦ ALBERT H. HOOKER, JR., Western sales manager of the Hooker Electrochemical Co., stationed at Tacoma, Wash., is now on active duty as a major in the Chemical Warfare Service.

✦ PAUL R. ASSMANN of Cincinnati, Ohio, is now in the military service.

✦ W. M. CONNERS, superintendent of the Canada Creosoting Co., Winnipeg, Man., Canada, is in the armed forces of that country.

✦ C. R. WAGNER, chief chemist of the Pure Oil Co., Chicago, Ill., has joined the military forces.

✦ FRANCIS C. SERIL of Schenectady, N. Y., has left his position to go into the army.

✦ C. J. ASTILL, assistant chief chemist of the Nevada Consolidated Copper Corp., Hurley, New Mexico, has left to join the armed forces.

✦ R. E. MEINTS of the Chemical Warfare Reserve has been ordered to active duty with a temporary station at the Chemical Warfare School, Edgewood Arsenal, Md. Lieutenant Meints received his Ph.D. degree at the University of Illinois in 1932, and for the past four years has been in the research and development department of National Aniline & Chemical Co., Buffalo, N. Y.

✦ HARVEY H. GRICE, formerly of the General Foods Central Laboratory at Hoboken, N. J., is in the military service.

✦ JAMES W. MILLIN is in the army. He is stationed at Camp Livingston in Louisiana.

✦ SEYMOUR H. MANN has been called to active duty. He received a degree in chemical engineering from C. C. N. Y. Lieutenant Mann is at Pine Camp, N. Y., where he is serving in the Chemical Warfare Service.

OBITUARY

✦ A. N. LINDBERG, president of the Lindberg Engineering Co. and the Lindberg Steel Treating Co., Chicago, died February 2. Mr. Lindberg was born at Narke, Sweden, in 1875 and came to the United States at the time of the Columbian Exposition.

✦ WALTER S. FRISBIE of the Food and Drug Administration, died February 19. He was chairman of the Food Standards Committee as well as chief of the Office of State Cooperation in the Administration. Mr. Frisbie died at his office in the Department of Agriculture, Washington, D. C. He was born in New Haven, Conn., May 11, 1881 and edu-

cated at Yale, Cornell and Johns-Hopkins, and had served as chemist for several states before going to Washington in 1921.

✦ ISAAC BROWN MERRIAM, president of Chattanooga Boiler & Tank Co., Chattanooga, Tenn., died January 23.

Alan G. Wikoff

✦ ALAN G. WIKOFF, editor-in-chief of the general publicity department of Union Carbide & Carbon Corp., New York, N. Y., died in White Plains, N. Y. on February 11 at the age of 46. His home was in Pleasantville, N. Y. He had been ill only one day.

Mr. Wikoff was born in Cooperstown, N. Y., and was graduated from the College of the City of New York with the degree of bachelor of science in chemistry in 1916, and received his master's degree in chemical engineering from Columbia University the following year. During the first World War he was connected with the Chemical Warfare Service, and on returning to civilian life, he joined the editorial staff of *Chem. & Met.* where he remained for six years. For the past 17 years he has been associated with Union Carbide & Carbon Corp.

✦ A. J. DORNBLATT died February 2 due to complications following a chest operation. Dr. Dornblatt was born at Athens, Ga., Dec. 12, 1905. He was a chemical engineering graduate of the University of Georgia and Columbia University. He had been with Colgate-Palmolive-Peet Co., Post Graduate School at Annapolis, Bureau of Standards, and at the time of his death was with Crown Cork & Seal Co. in Baltimore.

✦ CARL PFANSTIEL died March 1 at Chicago after suffering a stroke the previous day. He was 54 years old. He was vice-president and director of research of the Pfanstiel Chemical Co. of Waukegan, Ill., at the time of his death, and was the founder of the Fansteel Metallurgical Co. which he left 20 years ago.

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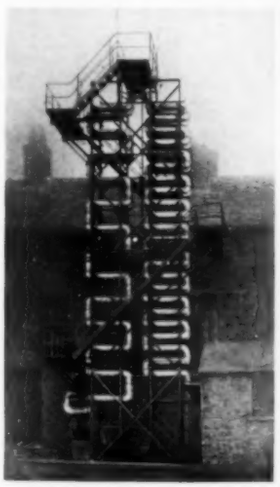

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7. Pipes and Fittings.
8. Vitreosil Industrial Crucibles, Dishes, Muffles, Pots, Retorts, Tanks and Trays.

THE THERMAL SYNDICATE, LTD.
12 EAST 46th STREET, NEW YORK, N.Y.

VITREOSIL

POROUS PACKINGS

For better wetting, more *usable* surface area or as catalyst carrier, an absorbent or porous packing is desirable. Porous Berl saddles, made of an acid proof, white, refractory material, offer those advantages in addition to their inherent superiority regarding exposed surface area, high loading capacity and low pressure drop per unit packed space.

Semi-porcelain Berl saddles are available in the ¼", ½" and 1" sizes.

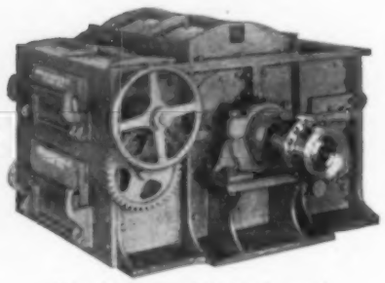
KNIGHT-WARE
"IT IS THE BODY ITSELF"

Kelly Ave. — MAURICE A. KNIGHT — Akron, Ohio

Chemical Raw Materials Crushed and Pulverized at Great Savings with

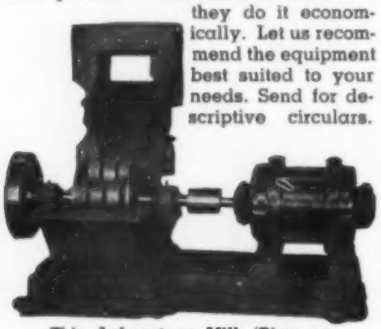
AMERICAN

CRUSHERS AND GRINDERS



This American Grinder is used for grinding glass and tank cullet, salt briquettes, sinter, skimmings, limestone, gypsum, oyster shells, phosphate rocks, etc.

● The reason for the great dependability of American Crushers, Grinders, and Pulverizers is that they are thoroughly tested for quality, wear, and endurance. They have wide operating range, are extremely flexible, all working parts are accessible, and they stay on the job day after day delivering greater tonnage per hour—more uniform product—minimum of fines and—they do it economically. Let us recommend the equipment best suited to your needs. Send for descriptive circulars.



This Laboratory Mill (Ring or Hammer) is used for the reduction of materials for the laboratory and incorporates many features of the larger units. Write for special bulletin.

AMERICAN PULVERIZER COMPANY

1219 Macklind Avenue
St. Louis, Missouri

ORIGINATORS AND MANUFACTURERS OF RING CRUSHERS AND PULVERIZERS

NEWS OF PRODUCTS AND MATERIALS

IMPACT RESISTANT RESIN

Announcement has been made of the development of a new impact-resistant phenolic molding plastic designated as Bakelite Phenolic XM-15000 by the Bakelite Corp., New York, N. Y. This product was developed to meet the needs of industry for a high impact-resisting molding material that can be preformed on automatic tabletting machines. When molded it has approximately twice the shock resistance of general purpose phenolics. Its water resistance is also good when compared with other shock-resistant phenolic plastics.

The physical and electrical properties of molded test pieces are as follows:

Physical (Molded):

Specific gravity—1.36—Weight per cu. in.—22.2 gm.

Tensile strength—5000–5800 lb. per sq. in.

Modulus of elasticity—10–13 x 10^5 lb. per sq. in.

Impact strength—Energy to break ft.-lb.—4.5

Impact strength—Per in. sq. ft.-lb.—4.8–6.3

Molding shrinkage—.005–.007 in. per in.

Flexural strength—8400–8800 lb. per sq. in.

Water absorption	% Gain	% Swelling
24 hours A.S.T.M. method	0.4–0.9	0.05–0.1
5 hours boiling 2-in. disc	1.4–1.9	0.26–0.38
24 hours boiling 2-in. disc	3.0–3.9	0.64–0.83

Heat resistance—Recommended for use where molded parts are to be subjected to temperatures up to 300 deg. F (149 deg. C)

Electrical (Molded):

Dielectric strength at 60 cycles—As is: 110–125 volts per mil (step)—Preheat 30 min. at 220 deg. F.: 250–275 volts per mil (step).

Volume restivity—As is: 2–3 x 10^5 megohms cm—Preheat 30 min. at 220 deg. F.: 5–6 x 10^5 megohms cm.

To secure good electrical properties the material must be preheated.

The physical and electrical data have been determined by A.S.T.M. (or standard) samples under A.S.T.M. (or standard) tests. Pieces were molded under conditions that would impart their best finished properties.

BLACKOUT GLUE

The blackout procedure may be accomplished by first painting with black paint and then applying Midland No. 222 Blackout Glue to the window panes and adhering waterproof paper, cardboard, fiber, or some other material. In this way the glue will also act as a shatter-proofing agent in the event of bombing. The glue may be applied with a brush or sprayed, and gives a permanent waterproof bond. It was developed by the Midland Glue Products Co., Detroit, Mich.

PLASTIC PROTECTIVE COATING

The process industries will be interested in the new type of liquid plastic coating which is said to be both acid and alkali proof. It is applied like paint, and after evaporation of solvents is an impermeable tough, dielectric membrane which adheres firmly to steel, concrete, wood and other surfaces. Lin-Tite liquid type coatings were developed by Adolphe Hurst & Co., New York, N. Y. Application consists of prime and top coats, and while procedure may vary in individual cases, a film is built up of several coats to afford adequate permanent protection. Some coatings need no primer. Lin-Tite coatings are used for permanent protection of metal-plating tanks, acid storage tanks, exhaust systems and wherever corrosive action is a factor.

METAL CLEANER

Metal may be cleaned by the use of Mascosol (formerly known as Solvtex W). This product was designed specifically for the removal of oil and grease from metal surfaces using a water emulsion. It is entirely neutral in character and thus may be used even on aluminum or magnesium without attack on these metals. In ordinary applications the recommendations for use in cleaning are to use 10 percent by volume of Mascosol in water at a temperature of 160 to 180 deg. F. For heavy-duty applications where chunks of grease and other materials which are difficult to remove are present, it may be necessary to increase the concentration to 20 to 25 percent. For the heaviest duty such as the removal of carbon and similar deposits, the concentration may be as high as 50 percent in water. Following the cleaning bath the work should be rinsed in two hot water rinses, or if these are not available, cold water sprays reaching every part of the articles. Macosol is a product of the MacDermid, Inc., Waterbury, Conn.

SYNTHETIC RUBBER

Because crude rubber formerly employed is now prohibited by the government for the manufacture of hand stamps, due to the war emergency, the B. F. Goodrich Co., Akron, Ohio, announces a new line of compounds made from Ameripol, the synthetic rubber developed in its own laboratories, and also compounds from reclaim rubber. They can be used in making hand-daters, logotypes, and toy stamping sets. Both compounds are black and vulcanize at 307 deg. F. The Ameripol compound has a durometer reading of 55, specify gravity of 1.22, and a ten-

minute cure, while the reclaim compound has a Durometer of 60, specific gravity of 1.27, and seven-minute cure.

METAL CLEANER

Metal may be cleaned and rustproofed by the use of Ruscat, recently developed by the research laboratories of the United States Stoneware Co., Akron, Ohio. The principal use of Ruscat is for the cleaning and preparation of metal surfaces before the application of corrosion-resistant paints and coatings, and also for the purpose of preventing further rust formation. The use of this material produces a mild etch over metal surfaces, resulting in the development of a chemically adherent inorganic base over which the lacquers and coatings are made to gain their maximum adhesion. A thorough chemical cleaning of the minute pores of the metal is achieved, along with the removal of all surface contamination, scale and rust. It may be applied by brushing or dipping. After a few minutes the solution may then be wiped off and allowed to dry.

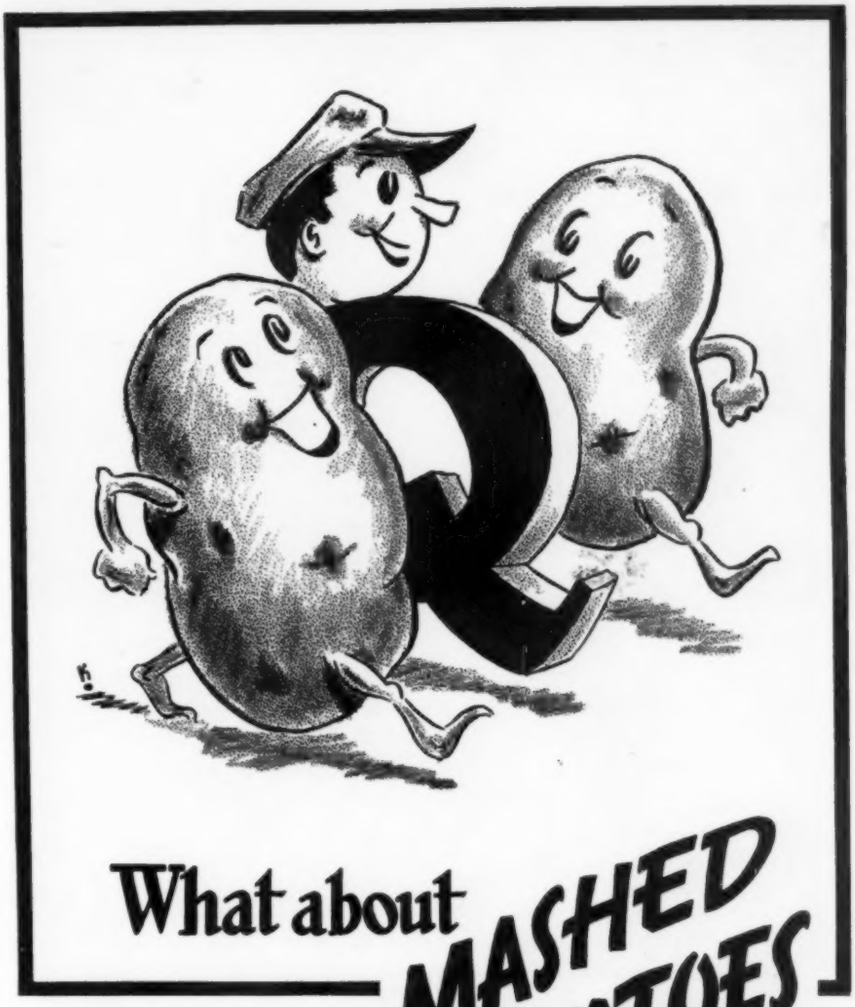
SYNTHETIC WAX

Japan wax may be replaced in some instances by Nipocer, a synthetic wax manufactured from domestic raw materials by the Glyco Products Co., Brooklyn, N. Y. It is a tan colored wax with a melting point of 46 deg.–49 deg. C. It blends with most waxes and resins, and is easily emulsified with the usual agents. It is superior to japan wax, in that it is less subject to oxidation and rancidification. It is being used in textile preparations, lubricants of various types, protective coatings, impregnants, polishes, and for most purposes where a wax with the properties of japan is desirable.

CAMOUFLAGE PRODUCTS

Anticipating the demand for effective camouflage, the Philip Carey Manufacturing Co., Lockland, Cincinnati, Ohio, during the past year, has developed the Rejuvo system of camouflage which, test installations are said to indicate, offers exclusive advantages.

Carey provides a blackout coating which is said to be non-reflective and to insure complete light stoppage with one coat. This coating is applied as a paint and is recommended for either inside or outside applications, but is particularly desirable for preventing light reflections on the outside surface of skylights. Carey blackout board is credited with effectively overcoming the danger from flying glass, at the same time solving the blackout problem. These boards of laminated asphaltic composition cut to window size are recommended by the manufacturer for application to the inside of the windows. They are of good rigidity, moisture and condensation proof, easily installed and quickly removable. To meet the demand for a more permanent weatherproof exterior blackout treatment, this manufacturer has developed



What about MASHED POTATOES?

THERE'S plenty of food for thought about "good pumping practice" in the way Quimby handles mashed potatoes. Probably most pump users have never considered pumping mashed potatoes, but this is only one of many pumping problems of industrial, chemical and process industries that Quimby has solved successfully and economically for the past fifty years.

If mashed potatoes mean nothing to you but gravy and roast beef we recommend a knife and fork, but don't forget that Quimby Pumps will also transfer mashed potatoes profitably and that Quimby engineers have half a century of practical experience with industrial pumping of all kinds—from extra special to run-of-mine.

THE BEST PUMP FOR THE JOB
IS THE MOST ECONOMICAL PUMP TO USE.

QUIMBY PUMP COMPANY, INC.
351 Thomas St., Newark, N. J.

QUIMBY PUMPS

Better Pumping Practice
SINCE 1894

THESE two tanks in the plant of Carnegie-Illinois Steel Corp., Duquesne, Pa., were lined with two courses of acid-proof brick laid entirely in Penchlor Acid-Proof Cement.* They are used for pickling steel bars where the mechanical as well as the chemical action is especially severe.

Due to their large size—45′ x 5′ x 4′—both tanks were built with expansion joints in their lining. Inspection after a year's constant use showed absolutely no signs of permanent expansion of the lining. Both bricks and cement are still in perfect condition.

This is typical of the way Penchlor Acid-Proof Cement stands up in tough service. It is inert to all acids except hydrofluoric. It adheres strongly to such materials as brick, steel, glass, carbon, lead, and rubber. Quick-setting and self-hardening, it speeds up acid-proof construction.

For extremely abrasive conditions, or where thermal shocks are extreme, Asplit Cement* provides utmost durability and prevents spalling of bricks. It is a synthetic resin that far outlasts other types of acid-proof construction.

Penn Salt has been engaged for a great many years in the manufacture of acids and alkalies. We have naturally had considerable experience in the use of cements to resist corrosion, and are in a position to give technical advice. We will welcome inquiries on your problems.

***Fully protected by *existing* patents.**

PENNSYLVANIA SALT MANUFACTURING COMPANY

Chemicals

1000 WIDENER BUILDING, PHILADELPHIA

NEW YORK · CHICAGO · ST. LOUIS · PITTSBURGH WYANDOTTE TACOMA

what it terms the Carey Laminated System, consisting of the application of a thick film of asphaltic coating in which is embedded an asphaltic-saturated fabric membrane, topping this with a finish of the asphaltic coating. This treatment, it is asserted, effects a complete blackout and renders the glass shatterproof. Damage to windows from air raids naturally pre-supposes damage to the blackout materials which cover the windows and the resulting need for quick, temporary repairs to meet this need. It is recommended that several rolls of a good, tough blackout paper be kept handy. Tests are said to show that Carey smooth roll roofing or the less expensive Carey asphalt-saturated building paper are ideal for emergency repair purposes.

RUST PREVENTATIVE

A new principle of rust prevention has been announced by the Milburn Co., Detroit, Mich., in the form of a cream known as Ply-Rustex, which is applied to the hands of the worker before contact with highly polished metal surfaces. This new step eliminates perspiration corrosion and other forms of rusting caused by the handling of metals during machining and processing operations. The extremely close tolerances required in precision parts has disclosed a high degree of ineffectiveness among conventional rust-preventative measures. In setting up or removing essential metal parts a fingerprint may cause a source of corrosion. Invisible at the outset, these focal points of rust are sealed in under ordinary rust prevention practice. With Ply-Rustex the worker applies the cream to his hands before touching any part of article to be machined or processed. This new technique enables free handling of the metal throughout the machining operation without gloves. Ply-Rustex is non-toxic and harmless to the skin. It is easy to apply like a vanishing cream, and it is removed with equal facility. Moreover, since it forms an impervious protective coating, it prevents irritations that may result in many forms of industrial skin disorders.

FEED WATER TREATMENT

A new organic colloid for use in the treatment of feedwater has been announced by the Bird-Archer Co., New York, N. Y., pioneers in the use of organic materials to supplement simple chemicals in the correct conditioning of boiler feedwater. Tanalginate is a new protective and reactive colloidal material. It is used in conjunction with such inorganic metals as phosphates or alkalis, and when used under competent supervision and control the results obtained are beyond the limitations of inorganic chemicals alone. Tanalginate can safely be fed through feed lines as it exhibits a positive inhibiting effect upon feed line deposits. It is supplied in several different formulations and pH values, depending entirely upon the nature of the water to be treated.

LATEX EXTENDER

Of interest to users of latex for cementing, impregnating and coating purposes, is a new method of processing that extends the volume of latex from 50 to 300 percent (depending upon the particular use to which it is to be put) while retaining the major characteristics of the original product, as well as a good proportion of its natural strength. After being extended by this new process, normal (38 percent) latex is returned to its owner in the form of a 37 percent concentration, and concentrated (60 percent) latex is returned in the form of a 55 percent concentration. Developed in the laboratories of the Union Bay State Co., Cambridge, Mass., the process makes use of a filler material of such fine size that it blends extremely well with the rubber particles. This effective blending characteristic, together with the filler material's many points of similarity to latex (it responds to the same reagents, has the same wetting out properties, penetrates and dries in the same manner, and even is susceptible to vulcanization) makes the extended product readily adaptable to most customary cementing, impregnating and coating operations. The efficiency of latex extended by this new process has been amply demonstrated in actual practice, and sufficient data are on hand to enable quick, accurate answers regarding the process's extending potentialities in connection with specific problems.

CEMENT

A new cement for use in laying insulating fire brick has been introduced after an extensive development program by the Building Materials Division of the Armstrong Cork Co.

Known as Armstrong's No. 2500 Cement, the new product is designed especially for use in laying Armstrong's A-16, A-20, and A-25 Insulating Fire Brick. This material provides improved workability, greater coverage, a high degree of cold bonding strength and hot bonding strength. Because the new cement is made up of high-grade refractory clays and grog, chemically and physically similar to the components of Armstrong's insulating refractories, it provides a coefficient of expansion of the dried cement virtually the same as the brick with which it is used, thereby eliminating cracking and peeling caused by differential expansion. This condition occurs where brick and cement do not have the same characteristics in this respect. No. 2500 Cement provides an excellent bond of moderate strength without possessing the bonding characteristics of an "air set" cement. It is particularly suitable for use directly exposed to furnace temperatures over 1,800 deg. F. Because a "fired bond" is not attained at lower temperatures, back up brick which are laid with the new cement can readily be salvaged with little or no loss.

Conserving and extending the usability of latex supplies is of great importance to America's war efforts.

2 Handy, Reliable Lebanon References Help to Answer Industry's Call for Information about Steel Castings

MANY industries feel the need for clear, *concise* information about steel castings. As part of the Lebanon program to provide such data, two "thumbnail encyclopedias" have been developed. Both are easy to keep handy . . . easy to use. Both have a definite place in the reference files of any user of steel castings.

CARBON AND LOW STRUCTURAL ALLOYS REFERENCE CHART (*upper*) — Concise data on Lebanon Carbon and Low Structural Alloys. Specifications, analyses and physical properties are given. Also included are comparable classifications of U.S. Government, S.A.E. and A.S.T.M.

STAINLESS STEEL CASTINGS REFERENCE CHART (*lower*)—Covers Circle (L) Stainless, Corrosion Resistant and Heat Resistant Alloys . . . shows wrought and cast materials of comparable analyses. Designations, alloying elements, physical properties, heat treatment are covered.

Both charts are available to executives, engineers and metallurgists upon request.

LEBANON STEEL FOUNDRY • LEBANON, PENNA.

ORIGINAL AMERICAN LICENSEE GEORGE FISCHER (SWISS CHAMOTTE) METHOD

CIRCLE L

LEBANON *Stainless and Special Alloy* STEEL CASTINGS

Guard—
YOUR WATER
SUPPLY SYSTEM

Beware of sabotage! Remember, in an emergency, your water system may save highly valuable materials, buildings and even lives.

Neglect is almost as destructive as sabotage. If your water supply system is not in tip top order, call in Layne and have necessary repairing and reconditioning done at once. Materials, except for strictly war work, may not be available later. Maintaining present equipment is real conservation.

If you require more water, arrange for additional wells and pumps without delay. Better call in a Layne engineer. He will cooperate with you in planning your additional water supply so as to use the minimum amount of materials essential to war work, yet give you an adequate, efficient and long lived installation. Layne wells and pumps are designed for your requirements regardless of size. They are noted for their high efficiency and trouble free service. They are serving all types of industries, municipalities both large and small, army and navy needs, training camps, flying fields and munitions plants.

Write, wire or telephone for further facts.

LAYNE & BOWLER, INC.
Memphis, Tennessee

LAYNE
PUMPS & WELL
WATER SYSTEMS

Affiliated Companies

Layne-Arkansas Company ..... Stuttgart, Ark.
Layne-Atlantic Company ..... Norfolk, Va.
Layne-Central Co. ..... Memphis, Tenn.
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Layne-Louisiana Company ..... Lake Charles, La.
Layne-New York Co. ..... New York City.
Layne-Northwest Company ..... Milwaukee, Wis.
Layne-Ohio Company ..... Columbus, Ohio
Layne-Texas Company ..... Houston, Texas.
Layne-Western Company ..... Kansas City, Mo.
Layne-Western Co. of Minn. ..... Minneapolis, Minn.
Layne-Bowler New England Corp. ..... Boston, Mass.
International Water Supply, Ltd. London, Ont.

WORLD'S LARGEST WATER DEVELOPERS

READERS' VIEWS AND COMMENTS

Readers are invited to express their views on articles appearing in Chem. & Met. *or on other subjects of interest to chemical engineers. As far as our space permits such views and comments will be published in these columns. Address your letter to the Editor of* Chem. & Met., *330 West 42 St., New York, N. Y.*

ANOTHER WORK-WEEK PLAN

To the Editor of Chem. & Met.:

Sir:—I was very much interested in the article appearing in January 1942 issue of *Chem. & Met.* entitled "A Work-Week Plan for Chemical Industry." There is no question but what this problem is one of the most important before a great many plants today, especially those plants which are operating on a round-the-clock basis. Where should more be known about this type of work than in the milk industry which had always been a seven-day per week proposition?

Since a year ago last March, we have been operating on three 8-hour shifts —24 hours per day—7 days per week. We have the type of operation which depends almost entirely on series work, that is, the operation of one machine depends entirely on the completion of the previous machine's work and it is practically all the type of work where the men can eat their lunch on the job. For that reason our shifts are set up on three 8-hour periods without overlap.

In the 22 years I have been in charge of food plants, I have proved definitely that the best hours of labor for shift changes for a food plant are 7 A.M. to 3 P.M.; 3 P.M. to 11 P.M. and 11 P.M. to 7 A.M. I know by close study with my employees that the less we disturb home life, the more contented the employee becomes and consequently the better employee he is. The shifts on which we operate are the least disturbing. Take breakfast for example: if the employee comes to work at 7 A.M. he can get up at 6 A.M., then the remainder of the family is eating breakfast about that time in order to get the children to school. I would say the breakfast period in the home of the average working man extends from 6 to 8 A.M. The same is true of the employee finishing his shift at 7 A.M. He is home in time to eat breakfast with his family. Then the housewife can complete the work in her kitchen by 8 or 9 o'clock.

Another example I would like to bring out is the night shift changes. The employee on the 3 P.M. to 11 P.M. shift gets home in time to get a good night's sleep and have a day with his family. The employee coming to work at 11 P.M. at least has had time to spend the evening with his family and when the children go to bed, he comes to work. This employee sleeps in the morning as soon as he has had his breakfast. I have tried the various shifts and times of day to start and much prefer the 7 to 3, 3 to 11 change.

Now, as to change of shift. We work our men in groups of six and there are seven men who know that particular job for each six men. The seventh man is what we call a relief man and each man on the shift serves his time as a relief man because he has the shifting time of day per day in week to come to work. In the plan you published, each man is shifted each and every day. With the plan which we use, each man in the group is off one day per week and every seven weeks, he gets Saturday and Sunday off together.

The plan works as follow: Employee "A" will work Sunday, be off Monday while the relief man substitutes for him, and then employee "A" will work the remaining days of the week. The next week employee "A" is off on Tuesday and so on each succeeding week. Then every two weeks the shift rotates, that is, employee "A" who works from 7 to 3 will change to the 11 to 7 shift and then after two more weeks he will take the 3 to 11 shift and the following two weeks he will revert back to his original schedule. Each and every employee gets the same amount of overtime per week and there are no long or short period shifts.

This system has been in service at our plant for some time and by publishing a schedule every Friday for the shift of the next week, the employee knows exactly when he will work that week and can plan his social life accordingly. If there are any readers of this letter who are interested in this plan and would like additional details, we will be glad to try and give assistance.

Management of factories today has a much greater load than in previous years and the best that can be done is to work together and try to find solutions for individual problems.

W. T. Robling
Superintendent
Manufactured Products Division
The Borden Company
Waukesha, Wis.

Sample Shift Schedule

Schedule for three eight-hour shifts, seven days per week jobs. In the particular plant where this scheme is in operation, men are grouped into units of seven for time allotment purposes. In the tabulation are shown the hours of one such unit. Workers take turns acting as "relief" man. The two men indicated as being in one shift are not necessarily in one department.

First Week

Hours	Sun.	Mon.	Tues.	Wed.	Thurs.	Fri.	Sat.
7- 3	AD	RD	AR	AD	AD	AD	AD
3-11	BE	BE	BE	BE	BE	BR	RE
11- 7	CF	CF	CF	CR	RF	CF	CF

Second Week

7- 3	AD	AD	RD	AR	AD	AD	AD
3-11	RE	BE	BE	BE	BE	BE	BR
11- 7	CF	CF	CF	CF	CR	RF	CF

Third Week, Shifts Changed

7- 3	BR	RE	BE	BE	BE	BE	BE
3-11	CF	CF	CF	CF	CF	CR	RF
11- 7	AD	AD	AD	RD	AR	AD	AD

Electrochemical Society and A.C.S. Hold Conventions in April

CHEM & MET NEWS OF MEETINGS & CONVENTIONS

ELECTROCHEMICAL SOCIETY TO HOLD CONVENTION IN APRIL

THE 81ST NATIONAL meeting of The Electrochemical Society will be held at Nashville, Tenn., April 15-18. Plans for the meeting are under the direction of Professor J. M. Breckenridge of Vanderbilt University. At this convention there will be a symposium on "Electric Furnace Reactions" in charge of Dr. John B. Sullivan of Battelle Memorial Institute, Columbus, Ohio, and one on "Corrosion" in charge of Dr. R. M. Burns of Bell Laboratories, New York, N. Y.

DUNLOP ELECTED HEAD OF COMPRESSED GAS ASSOCIATION

AT ITS ANNUAL meeting in the Waldorf-Astoria, February 26-27, the Compressed Gas Manufacturers' Association elected C. W. Dunlop of the Pintsch Compressing Corporation, New Haven, Conn., president for the coming year. H. Emerson Thomas of the Phillips Petroleum Co. was elected vice president and Thomas Coyle of E. I. du Pont de Nemours & Co. was named second vice president. F. R. Fetherston was re-elected secretary and treasurer.

MIDGLEY TO RECEIVE WILLARD GIBBS MEDAL

THE WILLARD GIBBS Medal for 1941, awarded to Thomas Midgley, Jr. by the Chicago Section of the American Chemical Society, will be formally presented on May 22, 1942. This is the 31st award of the medal, which has come to be recognized as one of the leading honors in American chemistry.

Among the accomplishments for which Dr. Midgley was selected were his development of an indicating device for determining what takes place in high-speed internal combustion engines (the Midgley indicator); work on the detonation characteristics of various types of fuels; development of a series of chemical antiknock agents, culminating in the discovery of tetraethyl lead and a method for manufacture of this compound; contributions to the knowledge of the chemistry of rubber and method of synthesizing rubber; and development of organic chloro-fluorides which have become important industrially as non-flammable, non-toxic refrigerants.

PAINT TECHNICIANS MEET IN SOUTH

THE ANNUAL convention of the Southern Paint Federation Association was held in the Peabody Hotel, Atlanta, Ga., February 26-28. An exhibit of materials and equipment for the paint industry was held throughout the meeting. Technical papers presented included discussions on natural resins in the paint and varnish industry, diatomaceous silica applications, drying oils, chemical pigments, modern filtration practice, and recent developments in pigments and paints.

AMERICAN CHEMICAL SOCIETY TO HOLD MEETING IN MEMPHIS

THE 103RD MEETING of the American Chemical Society will be held in Memphis, Tenn., April 20-24. Technical sessions will be held by 17 of the society's 18 professional divisions. More than 3,000 chemists are expected to attend the convention. Many of the papers will deal with chemical developments in the South and in the Memphis area and symposia will be devoted to recent progress in medicinal chemistry, vitamins, nutrition, agriculture and other fields.

W. F. Bowld, general manager of the Buckeye Cotton Oil Co., Memphis, has been appointed general chairman of the convention committee. The honorary chairman is Dr. Victor A. Coulter of the University of Mississippi. Registration will begin April 19 in the Memphis Municipal Auditorium. National arrangements are being made at the Society's headquarters in Washington under the direction of Dr. Charles L. Parsons, secretary and general manager of the Society.

ENGINEERING INSTITUTE OF CANADA HOLDS MEETING IN MONTREAL

MEETING FEBRUARY 5-6 in Montreal, the Engineering Institute of Canada held its 56th annual professional meeting in the Windsor Hotel. The Hon. C. D. Howe, Minister of Munitions and Supply of Canada, was one of the guest speakers.

Included in the sessions were papers on the organization of Research Enterprises, Ltd., a government-owned company established for the production of precision instruments, by W. E. Phillips, Research Enterprises, Ltd., Toronto; the new oil-hydraulic press in munitions manufacture, by J. H. Maude, Dominion Engineering Co., Ltd., Montreal; accident prevention methods and results, by Wills Maclachlan, Electrical Employers' Association of Ontario; the management-employee problem for engineers, by J. W. Parker, president, American Society of Mechanical Engineers; and the National Service, a challenge to engineers by E. M. Little, director of the Wartime Bureau of Technical Personnel, Ottawa.

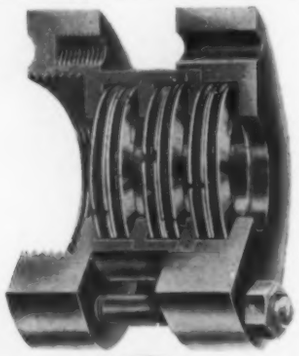
A.P.I. CANCELS TWELFTH MID-YEAR MEETING

THE TWELFTH mid-year meeting of the American Petroleum Institute, scheduled for May 25 to 28 in Oklahoma City, Okla., has been cancelled, according to W. R. Boyd, Jr., president.

Mr. Boyd explained that this action has been taken by the institute's executive committee upon his recommendation because so many of the members

CALENDAR

APRIL 15-18	The Electrochemical Society, spring convention, The Hermitage Hotel, Nashville, Tenn.
APRIL 19-24	American Ceramic Society, annual meeting, Hotel Netherland Plaza, Cincinnati, Ohio.
APRIL 20-24	American Chemical Society, semi-annual meeting, Municipal Auditorium, Memphis, Tenn.
MAY 3-5	The Society of Plastics Industry, annual meeting, The Homestead, Hot Springs, Va.
MAY 11-13	American Institute of Chemical Engineers, semi-annual meeting, Boston, Mass.



What Is the Life of FRANCE METAL PACKING

City of Erie, Pa., Waterworks: "The France Packing in a Holly pumping engine has been in service *32 years* and is still working satisfactorily."

Illinois Power & Light Corp., Champaign, Ill.: "France Metal Packing used on our engines for *27 years* and is still working under a pressure of 170 lbs. superheated. . . . will in all probability outlive us."

Worcester Gas Light Co., Worcester, Mass.: "France Packing has always been tight. . . . Same compressor packed with ordinary packing required a large amount of labor to keep the stuffing boxes tight."

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Original **FRANCE METAL PACKING**

of the institute, and especially of its working committees, who normally attend mid-year meetings, are actively engaged in war work.

"HUMANIZING ENGINEERING" LECTURE SERIES CONTINUED

THE EXPERIMENTAL course of features entitled "Humanizing Engineering," inaugurated as an experiment last Fall by the New School for Social Research, New York, N. Y., will be continued with the second series of 15 lectures by outstanding engineers in various branches of the engineering profession. The series will extend from February 4 to May 13. The course has been organized and conducted under the chairmanship of Dr. D. B. Steinman, designer of bridges and former professor of civil and mechanical engineering at the City College of New York.

Included in the series will be lectures on structural welding, problems of foundation engineering, the new science of soil mechanics, the engineer in national defense, reinforced concrete buildings, electrical research and development, modern scientific management, and the engineer's relation to economic problems.

SELECTIONS FROM CONVENTION PAPERS

RECOVERY OF PYRIDINE BASES FROM COKE OVEN GAS

TAR OR PYRIDINE bases are practically insoluble in neutral or alkaline solutions saturated with ammonium salts, so to remove them from saturator liquor from coke oven gas operations, it is only necessary to neutralize and remove the bases by distillation or by gravity. The natural neutralizing agent to use in a coke plant is the ammonia vapors from the crude ammonia stills. Operation of the Seaboard process for removing tar bases from saturator liquid as practiced in the plant of the Koppers Company is described below.

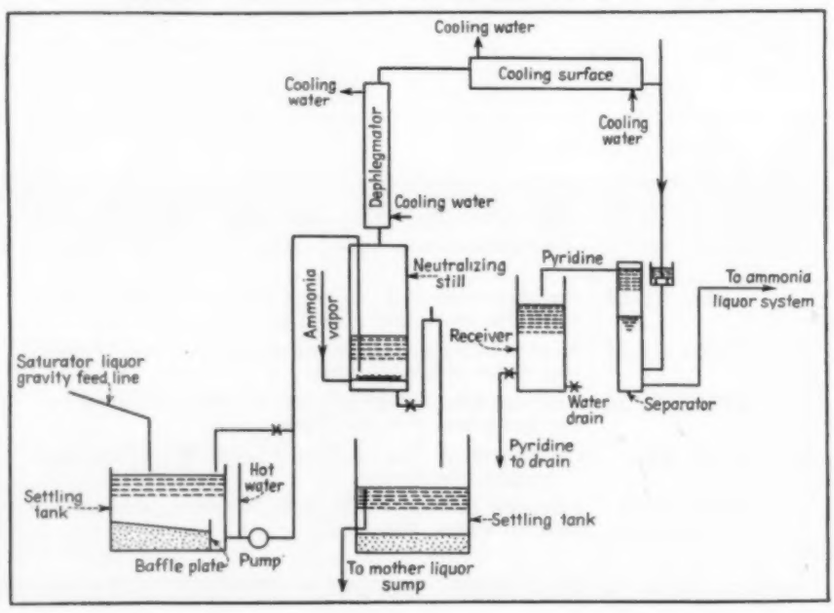
Liquor is removed from the drain tables intermittently about every two hours and discharged into a small lead-lined tank. It is pumped from this to the neutralizer at a rate of about 1.5 gal. per min. where it is met by ammonia vapor from the stills. Flow of these vapors is maintained at such a rate that the effluent from the bottom is just alkaline to litmus paper. The dephlegmator on top of the neutralizer is operated so that the vapors leaving it are maintained at about 92-96 deg. C. The condensed vapors flow into the separator and separate into two layers. The upper layer has a specific gravity of 1.002, contains all the tar bases and is run continuously to drums.

The lower layer, a strong solution of ammonium carbonate containing practically no tar bases is discharged to the ammonia liquor system. The continuous separation without preliminary salting out is possible only when the ratio of NH_3 to CO_2 in the vapor leaving the dephlegmator is such that the condensate contains enough ammonium carbonate to render the tar bases insoluble in it.

Effluent from the neutralizer is returned to the saturators. Ferrous sulphide and iron-cyanogen compounds precipitate out if it becomes alkaline and the removal of tar bases from the liquor is seriously reduced if it becomes too acid. It has been found that a pH of 6-7 is best.

This Koppers plant is carbonizing about 2,800 tons of coal per day and recovering approximately 1,400 gal. per month of crude tar bases having 20-30 percent moisture and 25-30 percent pyridine by volume and 500-600 grams

Koppers process for recovering pyridine bases from coke oven gas



per liter of total tar bases. The tar bases present contain about 50-60 percent pyridine. Recovery per ton of coal is as follows:

Crude tar bases	0.0168	gal.
Tar bases	0.070	lb.
Pyridine	0.042	lb.

H. J. Meredith, chief chemist, Koppers Company, Seaboard Division, Kearny, N. J., before the American Gas Association, Atlantic City, N. J., October 20–22, 1941.

• • •

Barium nitrophthalate has been used by the Germans as a paint for protection of iron work against rust. It is claimed to give excellent results even in aqueous emulsions. The covering power, though normally moderate, can be increased by addition of suitable dyes or pigments.

• • •

METHODS FOR REDUCING INTERNAL CORROSION OF GASOLINE PIPE LINES

RECENTLY DEVELOPED commercial methods for reducing the rate of internal corrosion of pipe lines include: (a) removal of oxygen from the gasoline by injection of an aqueous solution of sodium sulphite into the line; (b) removal of entrained and some dissolved water from the oil by passage over dehydrated commercial bauxite; and (c) use of mercaptobenzothiazole in the gasoline as a corrosion inhibitor.

Cost of corrosion in a gasoline pipe line is equivalent to $5,280 per mile times the cost in dollars per foot of pipe times the average percent corrosion per year. Obviously, this figure is conservative because corrosion is not uniform. This means that the cost attendant to leaks, maintenance of the line, scraping, etc., plus the effects on product quality should be added to the foregoing figure to give a true picture of the value of corrosion inhibition.

Internal corrosion of gasoline pipe lines can be reduced by careful attention to freedom of water and air, and to treating chemicals. As to the use of an inhibitor, the conclusion at this time is that it is better than a break-even proposition in terms of corrosion itself, with several important operating variables further favoring chemical inhibition. Further data are needed to give a more accurate picture.

W. A. Schulze, L. C. Morris, and R. C. Alden, Phillips Petroleum Co., Bartlesville, Okla., before the American Petroleum Institute, San Francisco, Cal., November 6, 1941.

• • •

Use of ZnO in rubber can be reduced if a mixture of 6.25 parts of ZnO, 33 parts of blanc fixe and 9¼ parts of clay per 100 parts of rubber are used as a filler.

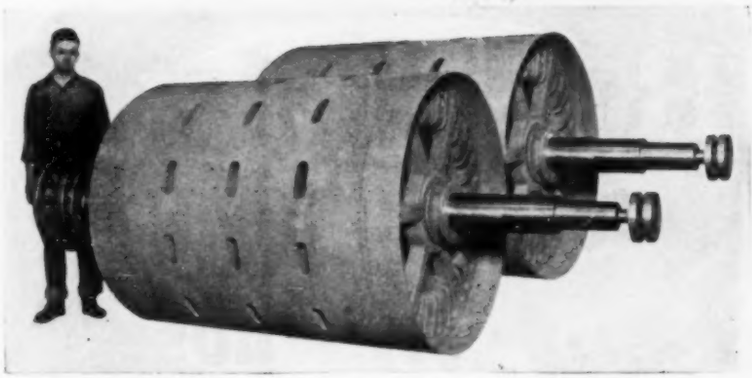
• • •

CHEMICAL INDUSTRIES OF VIRGINIA

GROWTH OF CHEMICAL industry in Virginia has been phenomenal during the past 20 years. Hopewell, on the James River about 20 miles below Richmond, is a good example of chemical industry concentration.

Here is the atmospheric nitrogen fixation plant of the Solvay Process Co.

Not 1 but 2 WORLD'S LARGEST!



We design and manufacture magnetic pulleys in all sizes, large and small, as part of our daily production.

These two happen to be interesting, not only for their tremendous proportions, 48" diameter by 64" length, but also from the fact they go into one of the country's largest copper mining and reduction plants.

You'll find Stearns Magnetic air-cooled (for more power) pulleys in outstanding mining and manufacturing operations everywhere, fitting proof of a better engineered product, a most for the dollar piece of magnetic equipment.

Should you have a problem involving the use of magnetic pulleys, write for Bulletin 302. No obligations. Get the facts.

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Flexible METAL Hose

Sizes from ⅛" I. D. to 4" I. D. inc. Pressures to 14,500 p.s.i. Temperatures to 1000° F. One-piece, all-metal construction. Continuous lengths to 50 feet.

Rex-Tite Mechanical (Re-attachable) couplings; solder couplings; brazed and welded couplings and flange assemblies for Rex-Weld Flexible Metal Hose.

Complete Data on Request

CHICAGO METAL HOSE
CORPORATION
MAYWOOD, ILLINOIS

Ferric sulphate can be used for pickling stainless steel in place of HNO_3 and for copper alloys in place of sodium dichromate, both now necessary for the war effort. Economics in processing are claimed as well as a reduction in metal loss of 30-50 percent.

• • •

with a capacity approximately equal to that of all other such American plants combined. It is the second largest plant in the world for fixing atmospheric nitrogen. The Haber-Bosch process is used wherein nitrogen from the air is purified and under high temperature and pressure (6,000-7,500 lb. per sq.in.) is combined with hydrogen to form ammonia. Some of this ammonia is converted into ammonium sulphate or oxidized to HNO_3 from which nitrate of soda is made.

Also at Hopewell, there is an alpha-cellulose pulp mill operated by the Hercules Powder Co., that uses cotton linters as raw material. This plant is the largest establishment of its kind in the world.

In less than a quarter of a century, Virginia has become the leading state in the production of chemical yarn. The first rayon unit was located at Roanoke in 1917 by the American Viscose Corp., followed by the nitrocellulose rayon plant of the Tubize Chatillon Corp. at Hopewell. The Industrial Rayon Corp. selected Covington as the site for a large viscose plant and the duPont organization established an acetate plant at Waynesboro. The latter built its largest viscose rayon plant at Ampthill on the James River. Manufacture of cellulose film is also carried out by the large plant of the Sylvania Corp. near Fredericksburg.

Rayon plants have been placed in operation recently by the American Viscose Corp. at Front Royal and the Celanese Corp. of America in Giles County. The new nylon yarn plant of duPont at Martinsville started production the latter part of 1941.

A new chemical industry in the Tidewater section is the large plant erected at Jarratt by Johns-Manville Corp. for the manufacture of insulating board. This plant obtains its pulp wood requirements from native pine. In addition, there are 44 fertilizer plants in the state, 21 of which are located in the

• • •

Manufacturers of ferrochromium have agreed to change specifications to permit use of lower-grade chrome ores. Present specifications of 68-69 percent chromium, 4-6 percent carbon, and 1-2 percent silicon will be changed to 60-63 percent chromium, 6-8 percent carbon, and 4-6 percent silicon. The agreement affects the type of ferrochromium used in making engineering steels running up to about 3 percent chromium, but does not affect stainless steel and heat-resistant alloy steels. The new specifications are approximately the same as those in use during the first World War.

Hampton Roads area. Ten of these plants are complete fertilizer works, producing superphosphate from phosphate rock and H_2SO_4. The others are "dry mixers," where superphosphate, potash, and nitrogen compounds are blended. Six of the so-called "complete" fertilizer plants have H_2SO_4 chamber processes.

The chemical industry has the largest capital investment of any industry in Virginia, accounting for more than 40 percent of the state's total plant investment. However, the total number of chemical plants is less than 10 percent of the total manufacturing plants in the state. The cellulose operations are probably the largest in volume from a financial standpoint.

R. C. Bardwell, Chesapeake and Ohio Railway Co., Richmond, Va., before the American Institute of Chemical Engineers, Virginia Beach, Va., November 3-5, 1941.

• • •

A recent survey has indicated that in 20 localities in North Carolina and Georgia there are easily available some 230,000,000 tons of olivine, ferrous magnesium silicate, containing more than 45 percent MgO and one billion tons averaging about 44 percent MgO.

• • •

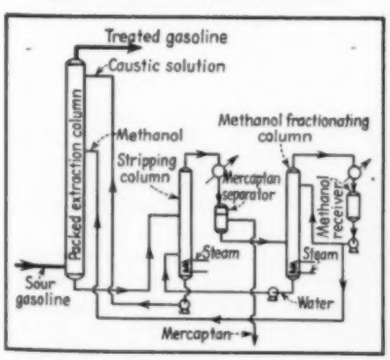
MERCAPTAN EXTRACTION BY CAUSTIC-METHANOL PROCESS

A NEW PROCESS, developed by the Atlantic Refining Co., removes essentially all mercaptans from sour gasolines by extracting them with only 2 percent strong NaOH and a suitable quantity of methanol. The process has been successful and several large plants are now under way.

Sour gasoline, essentially free of H_2S, flows upward through a counter-current extraction tower packed with Raschig rings. Regenerated NaOH solution is pumped to the top of the tower and, in flowing down through the upper section, removes practically all the methanol from the de-mercaptanized gasoline. Lower in the column, the methanol is introduced and the combined solvents extract the mercaptans from the gasoline.

Spent reagent from the bottom of the reaction tower is pumped to a steam-stripping tower of conventional design. From the bottom of this tower regenerated NaOH is withdrawn and recycled to the top of the extraction

Removal of mercaptans from sour gasoline by caustic-methanol extraction



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With war orders reducing the speed of delivery—with all emphasis on getting equipment that will stand up in the emergency—with all efforts directed toward conserving metals and alloys—engineers will make frequent use of this ready reference covering *all* the facts about what to look for when specifying stainless steel processing equipment:

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3. How will you design for economy and for conservation of steel?
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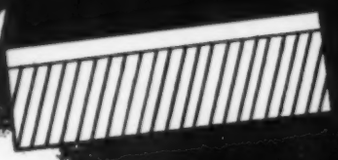
Stainless-Clad Steel*

The average sheet or plate of SILVER-PLY Stainless Clad Steel has a 20% stainless steel cladding.



A PEACETIME ECONOMY
AVAILABLE FOR WARTIME CONSERVATION

• Before the start of the defense program, an appreciable tonnage of Jessop SILVER-PLY Stainless-Clad Steel had been purchased for purely economic reasons. Utilizing a relatively thin layer of stainless on a cheaper mild steel backing, SILVER-PLY offered very definite savings in material costs—especially in thick sections. In addition, the superior thermal conductivity of SILVER-PLY permitted substantial savings in fuel costs, and the greater ease of drawing reduced fabricating costs.

The economic reasons for using Jessop SILVER-PLY Stainless-Clad Steel are still valid today, but equally important is the fact that SILVER-PLY permits great savings in strategic stainless alloys. A 20% clad sheet or plate, for example, uses only 1/5 as much stainless steel as a sheet or plate of solid stainless steel of the same thickness. In other words, a given amount of stainless or of nickel and chromium can be made to perform five times as much service without sacrifice of inherent corrosion resistance, when used in the form of Jessop SILVER-PLY Stainless-Clad Steel.

While the war has accelerated the use of SILVER-PLY, its cost saving features assure a continued acceptance during the peace to follow. Why not familiarize yourself with Jessop SILVER-PLY Stainless-Clad Steel today? Write for our 24-page descriptive booklet and our new price list.

* Produced under U. S. Pat. Nos. 1,927,538 and 2,044,742

JESSOP STEEL COMPANY
WASHINGTON, PENNA. U. S. A.

JESSOP STEELS FOR AMERICA AND HER ALLIES

CARBON • HIGH SPEED • SPECIAL ALLOY • STAINLESS • COMPOSITE STEELS

tower. The overhead from the stripper (a mixture of methanol, mercaptans and steam) is condensed and separated into two layers in the receiver. Mercaptans collect in the upper layer and are withdrawn from the system. The lower layer is a water-methanol mixture maintained low in mercaptan content by controlling the water-methanol ratio to give minimum mercaptan solubility.

Water-methanol mixture drawn from the bottom of the mercaptan separator is charged to the methanol fractionator. The methanol taken overhead is recycled to the middle section of the extractor. The water residuum from the fractionator is recycled to the caustic stripper.

Only 10 lb. of steam per barrel of gasoline is required for reagent regeneration. If costs of power, water, labor, etc. are added, a manufacturing cost of about one cent per gal. of naphtha, including reagent loss, is reached. From the standpoint of lead susceptibility and octane number, data have shown that at least 0.25 ml. of tetraethyl lead per gal. of gasoline can be taken as a credit.

From the plant investment angle, precise figures are difficult to give due to variations arising as a result of differences in capacities and local conditions. For a plant of about 5,000 bbl. per day, the investment should range from $8-12 per bbl. per day.

C. F. Mason, R. D. Bent, and J. H. McCullough, the Atlantic Refining Co., Philadelphia, Pa., before the American Petroleum Institute, San Francisco, Calif., November 6, 1941.

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A rubber reinforcing filler has been produced by treatment of precipitated silica with a magnesium salt. This is claimed to be a suitable substitute for ZnO, $MgCO_3$ and colloidal clays.

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MEASURING HYDROGEN SULPHIDE AND CARBON DISULPHIDE

A PRECISION METHOD for determining nitric oxides, carbon disulphide and hydrogen sulphide has been developed by the United Gas Improvement Co. of Philadelphia. The instrument estimates very small amounts of these gases in a mixture of air and has been devised for continuous automatic action.

The apparatus consists essentially of three parts: (a) a sampling and absorption system with a reagent; (b) a photoelectric colorimeter with its electrical system; (c) a potentiometer chart recorder. The range of the apparatus may be varied to suit the application, but a tentative range of 0-0.5 grain H_2S per 100 cu.ft. or 0-8 p.p.m. has been used for purified distribution gas. The scale is straight-line-uniform for this range, and the least scale division is 0.01 grain or 0.15 p.p.m. The color intensity characteristics of the reagent will allow a range of 45 p.p.m. in which the scale will be uniform up to 30 p.p.m. Modification of the electrical measuring circuit will allow a scale range less than 8 p.p.m. while for gases with an H_2S

content above 45 p.p.m. a dilution system is necessary.

The recorder is sensitive to changes in concentration of 0.08 p.p.m. The reagent is specific for H_2S, is stable and is not affected by light. It is readily prepared from c.p. chemicals and all reaction products are soluble, so that no zero drift occurs. The reagent develops shades of blue-green in presence of H_2S.

In addition to uses in the manufactured gas industry, the recorder has additional applications in such industries as rayon, compressed gases, and plants where toxic, destructive or explosive mixtures are likely to occur. Indicating devices which may be used with the equipment include meters, signal lights, warning bells or other devices to control processes, increase ventilation or close off supplies of gas.

W. E. Stackhouse, chemical engineer, United Gas Improvement Co., Philadelphia, Pa., and Baxter Reynolds, Rubicon Co., Philadelphia, Pa., before a Safe Practice Conference sponsored jointly by the Pennsylvania State College and the State Department of Labor and Industry, Pittsburgh, Pa., November, 1941.

• • •

Thermit, a mixture of Fe_3O_4 and aluminum powder, will burn at a very high temperature to produce molten iron and Al_2O_3. The reaction is over quickly so that there is no prolonged source of ignition. Thermit bombs cannot be extinguished and because of the short time of the reaction, there is little opportunity for such. Fires resulting from thermit should be fought in the same way as any ordinary fire.

• • •

SULPHUR DIOXIDE AS A RAW MATERIAL

METHODS BY WHICH sulphur dioxide gas may be obtained from combustion gases of high-sulphur coals at a cost comparing favorably with that of pure SO_2 from brimstone have recently been described. In the paper industry, a new development makes use of a cyclic process in which SO_2 is recovered from the waste sulphite liquor, thereby reducing the consumption of sulphur as well as providing complete disposal of waste liquor. In the oil industry, the Edeleanu (liquid SO_2) extract from a narrow boiling kerosene fraction provides an important source of toluene.

Selective extraction of vegetable oils with liquid SO_2 accomplishes separation into a highly unsaturated fraction having fast-drying properties and an oil having low iodine number suitable for edible purposes. New thermoplastic sulphur dioxide-olefin resins produced by reaction of liquid SO_2 with certain refinery gases have been reported. Sulphur trioxide is increasing in importance for the production of sulphamic acid and certain chlorosulphonates. Sulphuryl chloride and thionyl chloride, formed from SO_2 and chlorine, find in-

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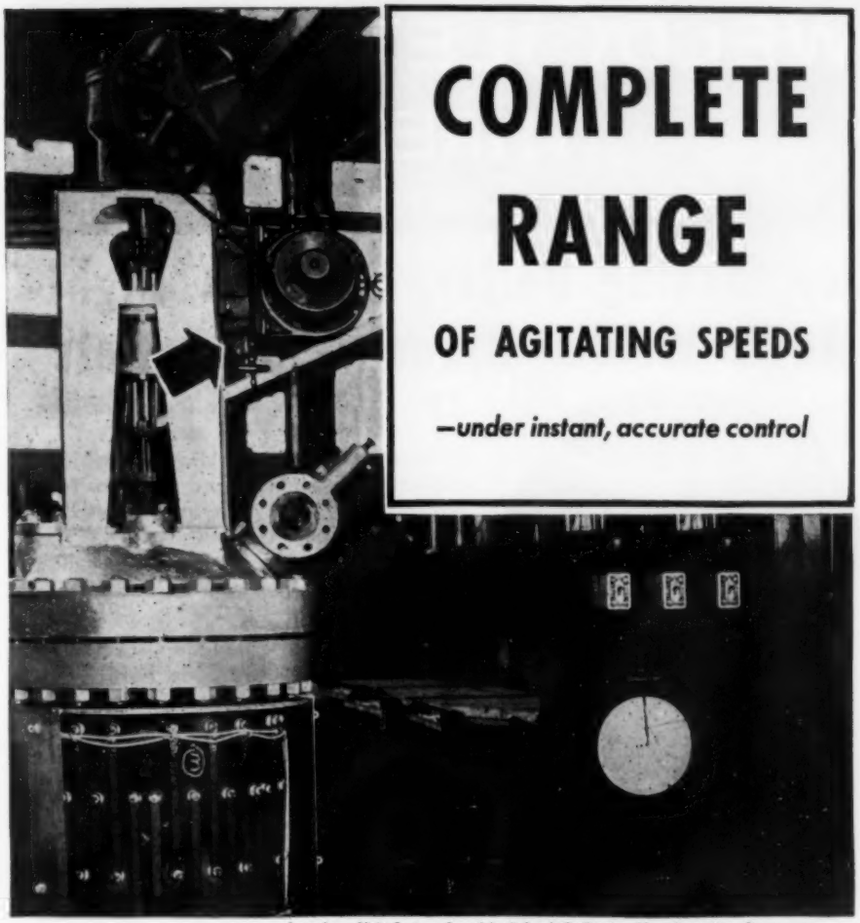
Urea can be used with iron salts for tanning purposes. A great deal of leather is tanned with such materials in Germany so as to conserve natural extracts and chrome salts.



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—under instant, accurate control

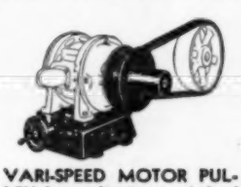
Autoclave Unit designed and built by J. P. Devine Manufacturing Company

This electrically heated, high pressure autoclave, shown in use in a large pharmaceutical plant, is equipped with a REEVES Vari-speed Motor Pulley which provides agitating speeds varying from 44 to 132 R.P.M. This wide range of speeds is under instant and accurate control. The exact speed required to give best results on different products can be had simply by turning a handwheel—without stopping the machine. REEVES Speed Control units are standard equipment on many leading types and makes of chemical machines, and are easily installed on machines in service. Catalog-Manual G-397 pictures and describes many helpful examples. Write for it. No obligation.

REEVES PULLEY COMPANY, *Dept. CM*, COLUMBUS, INDIANA

THE 3 BASIC UNITS IN THE MODERN REEVES LINE

VARIABLE SPEED TRANSMISSION for infinite speed control over wide range—2:1 through 16:1. Fractional to 87 h.p.



VARI-SPEED MOTOR PULLEY for application to shaft of any standard constant speed motor, 3:1 range. To 15 h.p.

MOTODRIVE—Combines motor, variable speed drive and gear reducer (if needed). To 10 h.p., speed range 2:1 through 6:1.

REEVES ACCURATE POSITIVE **Speed Control**

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For Making Better, Stronger Right-Angle Welded Branch Pipe Outlets

WeldOlet

BECAUSE they make leakproof junctions of full pipe strength . . . . because they improve flow conditions, reducing turbulence and friction to a minimum . . . . Bonney WeldOlets, ThredOlets and Socket-End WeldOlets will make better, stronger right-angle branch pipe outlets than any other type of fitting.

No templets are needed. The fitting is used as a templet. The hole in the main pipe, in most cases, is cut after the fitting is installed. They eliminate all threading and fitting of the main line and simplify alignment of main and branch pipes.

Standard, stock fittings in size-to-size and reducing sizes are of drop forged steel. For special applications or where unusual conditions exist, they can also be supplied in Toncan Iron, wrought iron, brass, Monel, Everdur, etc. WeldOlets, ThredOlets and Socket-End WeldOlets are suitable for every type of piping installation and for all commonly used pressures and temperatures.

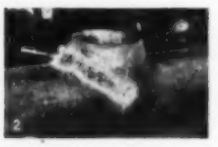
Your local distributor will be glad to tell you the complete story about savings which can be effected, or write for Bulletin WT29—TODAY.

ThredOlet

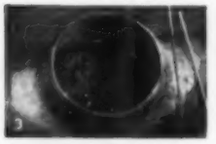
Socket-End WeldOlet

EASILY INSTALLED

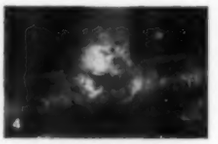
Mark center lines and tack the fitting into place.



Then weld the fitting to the main pipe.



Remove the button, which will also permit inspection of inside of joint.



Then attach the branch pipe.

BONNEY FORGE & TOOL WORKS

Forged Fittings Division - Allentown, Pa.

Forged by the Makers of

The Finest that Money Can Buy

BONNEY TOOLS

creasing use for chlorination of organic and inorganic materials.

Reduction of SO_2 with coke now supplies large quantities of elemental sulphur. Recent work on catalytic reduction of SO_2 with natural gas indicates that carbon disulphide and carbonyl sulphide, as well as elemental sulphur, are formed. Recently the use of zinc and sodium hydrosulphites in bleaching vegetable proteins has attracted attention.

H. F. Johnstone, University of Illinois, Urbana, Ill., before the American Chemical Society, Symposium on Physical and Inorganic Chemistry, Columbus, Ohio, December 29–31, 1941.

• • •

Grammar school children are fighting incendiary bombs successfully in England. They are not afraid because they understand and have been trained thoroughly. Knowing just what to expect and what to do in an emergency is half the battle.

• • •

BLACKOUTS AND ENGINEERING INGENUITY

BLACKOUTS IN America will be complicated and expensive. Unfortunate too, have been the misguided and uncoordinated actions of the public in rushing to purchase blackout materials badly needed for more important war activities. More Yankee ingenuity and engineering talent and less frantic thoughtlessness should be applied to the blackout problem.

Sudden emergencies that faced London two years ago, coupled with the varieties of electrical services, the great number of gas lighting units, the proximity of the enemy, and the existence of almost continuous night bombing, demanded complete exterior blackouts. By contrast, the probability of only sporadic raiding or token bombing in the United States, remoteness of any enemy land bases and the variety and spacing of targets make it highly questionable whether American cities should blindly copy London practices.

It is difficult, if not impossible, to extinguish all light sources quickly over the necessarily large area at the time of raids. Extinguishment is made more difficult by the existence of blast furnaces, slag dumps, farmhouses, buildings remote from telephones or sirens, railway switch and semaphore signals, etc. When moonlight fails to reveal targets, flares and incendiary bombs will usually light the way. In spite of London's expensive blackouts (during which 10,000 casualties were incurred during 1941) not a single suburb, business district, or defense area was spared from enemy bombing.

On the other hand, partial blackouts or "dimouts" would enable cities to maintain sufficient lighting for essential activities, but would mask the location of railway terminals, bridges, factories and traffic arteries. The net

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A recent British report states that there has not been a serious factory fire started by an incendiary bomb in any plant where the building was protected with automatic sprinklers.

effect would be a confused checkerboard of faint illumination in which all strategic landmarks would be blacked out.

S. G. Hibben, Director of Applied Lighting, Westinghouse Electric & Mfg. Co., Bloomfield, N. J., before the Associated Engineering Societies and the American Chemical Society, Cincinnati, Ohio, January 21, 1942.

• • •

Anhydrous $CaSO_3$, which occurs in Great Britain as a mineral and which can also be produced from gypsum, is being offered as a compounding ingredient for the rubber industry in place of barytes and whiting.

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FLOW OF PULP SLURRIES OVER WEIRS

PLANT TEST WORK has demonstrated the desirability of direct rate measurements of pulp slurry flows by means of weirs. Since no data on this subject are available, tests were run using 4, 6, 9, and 12-inch sharp-edged rectangular weirs, at rates of flow up to 220 gal. per min. Both beaten and unbeaten spruce sulphate pulp slurries of freeness 400 and 650 cc. were used; consistencies ranged from zero for clear water to 3.5 percent of moisture-free pulp in pulp and water.

Results indicate that the flow of slurries up to one percent consistency can be calculated satisfactorily by means of the Francis equation for water flow over suppressed weirs. For any head of slurry above the weir base, increasing the consistency beyond one percent results in a decrease in flow. This effect is more pronounced with free stocks, and may result in a flow which is only 30 percent of the value of water. Data are presented from which the flow can be calculated under specific conditions.

Although the flow for the different weirs was not found to be in the direct ratio of their widths, it is believed that such a proportion is reached for weirs wider than one foot.

R. P. Whitney and J. D. McNitt before the Technical Association of the Pulp and Paper Industry, New York, N. Y., February 16–19, 1942.

• • •

Caustic calcined magnesite is being used for recovering SO_2 from flue gases. The magnesium sulphite formed is calcined to regenerate MgO and to release SO_2, which can be used for making H_2SO_4.

• • •

EFFECTS OF COMPLEX DEOXIDIZERS ON CARBON FORGING STEELS

IT HAS BEEN reported that hardenability and toughness of forging steels can be improved by use of complex deoxidizers containing titanium, aluminum and vanadium. In the light of these results, an investigation of similar deoxidizers containing various hardening and grain-refining elements was undertaken.

These deoxidizers included three manganese-silicon-aluminum-titanium alloys with and without boron and calcium, three titanium-aluminum ferroalloys with vanadium, molybdenum, and zirconium respectively, and alumi-

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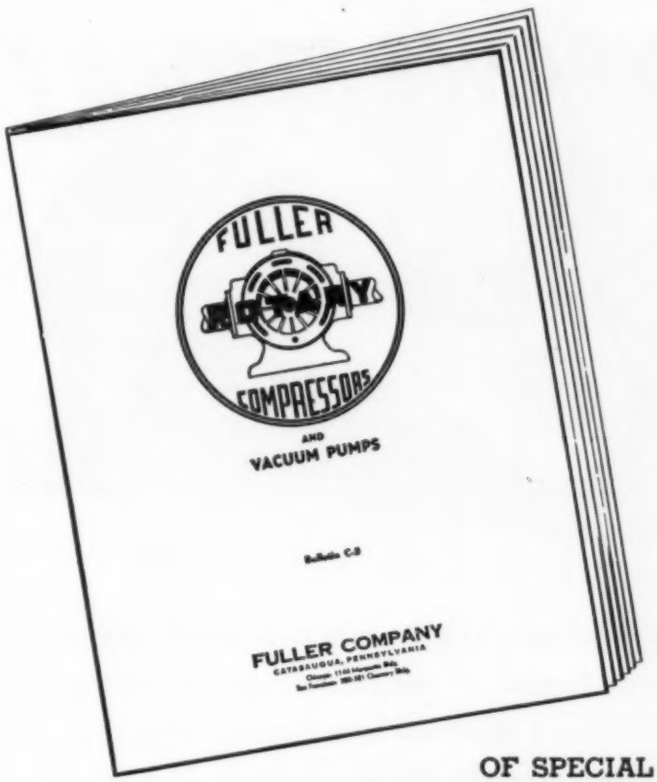

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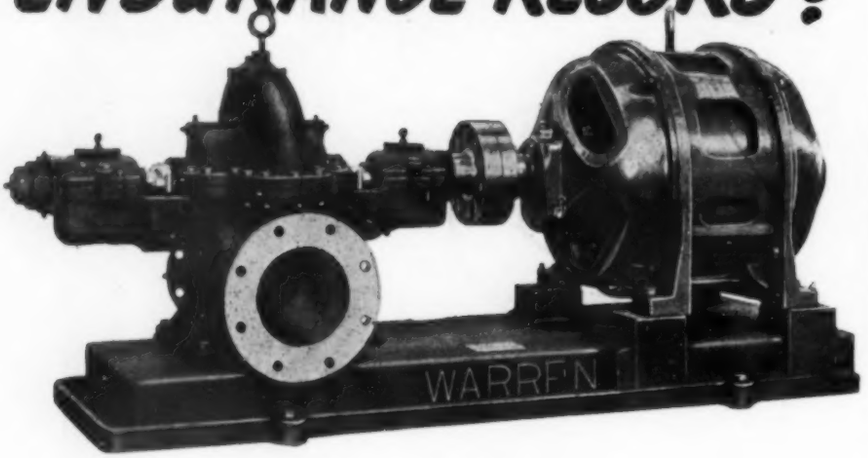

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num-zirconium ferroalloy and plain ferroboron.

Incorporation of minute amounts of boron in fine-grained 0.40 percent carbon steels is surprisingly effective in increasing hardenability. Small boron additions also gave good ductility and superior toughness, with high strength, after hardening and drawing at low temperatures such as 450 deg. or 650 deg. F. When drawn at higher temperatures to hardness values below about 45 Rockwell C, the superiority and toughness of steel so treated over steel similarly treated, but without boron, disappears.

Amount of boron that should be present in these 0.40 percent carbon steels to secure advantages in hardenability and toughness appears to be about 0.002-0.007 percent. To secure a superior combination of strength and ductility, together with high hardenability in fine-grain steel of this nature, it is advantageous to add the boron in the form of a complex titanium alloy rather than as ferroboron.

G. F. Comstock, metallurgist, Titanium Alloy Mfg. Co., Niagara Falls, N. Y., before the American Institute of Mining and Metallurgical Engineers, New York, N. Y., February 3–12, 1942.

• • •

Heavy calcium carbonate can often be substituted for U.S.P. ZnO in certain proprietary compounds. Dermatologists have frequently used $MgCO_3$ and $CaCO_3$ to replace ZnO in dry powders. Chlorothymol can often be substituted for phenol, cresol and formaldehyde; citric acid for tartaric acid, and tribasic calcium phosphate for $MgCO_3$.

• • •

CAUSTICIZING, REBURNING, AND SETTLING IN SULPHATE LIME RECOVERY

THIS WORK had three objectives: (1) to investigate the influence of Na_2S and other constituents present in commercial process sulphate green liquors on the causticizing reaction; (2) to furnish laboratory data on the reburning of typical sulphate lime "mud"; and (3) to attempt a correlation of the settling-rate data with the physical properties of the finished "white" liquor and the dry washed "mud."

Results demonstrated the effect of using lime in excess of that required to obtain the equilibrium causticizing efficiency by increased difficulty in washing, pronounced decrease in settling-rate, and a larger final sludge volume. It was found that the reburned lime from an actual sulphate lime "mud" settled twice as fast on recausticizing when reburned at 1320 deg. C. in a laboratory muffle furnace as that at 1100 deg. C., the availabilities of the reburned lime being the same.

On recycling lime particles through the causticizing and reburning process, it was found that the settling-rate of the sludge increased to a value 15 to 20 percent higher than when "new" lime was used.

Laboratory data indicated that less than one percent of Na_2O should be left

in the lime mud before reburning. A greater amount gave marked soda losses, decreased "availabilities," and slower settling lime sludges.

Variations in the initial settling rate of typical sulphate lime sludges, caused by changes in slurry temperature, solids to liquid ratio, and washing, were satisfactorily correlated by a simplified modification of the McCabe-Egolf method. A straight line relationship was obtained by making a log-log plot merely of the initial settling rate versus the factor.

G. B. Hughey, L. K. Herndon and James Withrow before the Technical Association of the Pulp and Paper Industry, New York, N. Y., February 16–19, 1942.

• • •

Commercial tanning agents are being made in Germany by the interaction of lignin with sulphonic acid or its salts or sulphite cellulose effluent.

• • •

DETERMINATION OF METALLIC MINERALS BY CONTACT PRINT METHOD

A RECENTLY developed print method permits ready location and identification of metallic minerals in ore samples. The value of the process lies in the fact that the actual mineral present is definitely identified, not just as the metallic element, but as the compound. With copper ore, for example, the technique would show definitely whether the metal was present as such, or in the form of oxide, carbonate, or sulphide.

A small sample of the ore is imbedded in lucite and then carefully polished. A photomicrograph in black and white is then made of the exposed surface. Gelatin-coated paper, treated with a specific attacking agent, is then applied under pressure to the mineral surface, with the result that an infinitely small film of the mineral present is dissolved in the gelatinized surface.

This contact print is then developed with special organic spot reagents, the mineral film coming out in certain specific colors, each color denoting a definite metallic compound. By superimposing the transparent color print on the photomicrograph, the breakdown of the mineral composition of an ore can be easily obtained. The same technique can be applied to concentrates or tailings.

The contact print method has aided in the solution of metallurgical problems which otherwise could be solved only by very elaborate methods and at times might even remain unsolved. In one case a company was interested in the nickel-bearing rock below the main ore body. The new print method showed that the nickel was diffused through the rock itself, forming concentration zones in the most altered parts of the latter, and that any milling method other than a hydrometallurgical treatment would prove hopeless.

Gregoire Gurzeit, research metallurgist, The Dorr Co., Inc., Westport, Conn., before the American Institute of Mining and Metallurgical Engineers, New York, N. Y., February 9–12, 1942.

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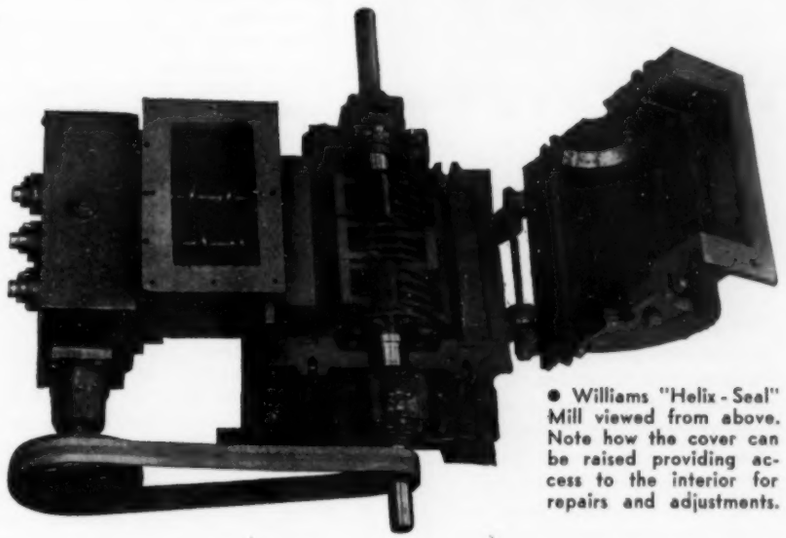

• Williams "Helix-Seal" Mill viewed from above. Note how the cover can be raised providing access to the interior for repairs and adjustments.

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SELECTIONS FROM FOREIGN LITERATURE

SOLUTION OF METALS IN ACIDS

IN A local cell, formed in a metal as a disk-shaped inclusion with radius r_0, the specific resistance of the cathode is $2r_0\pi x$ (where x is the specific conductivity of the electrolyte). This equation is applicable only if the anode is unpolarized and the cathode is strongly polarized. Using it to study solution behavior of metals in acids it was found, for zinc dissolving in sulphuric acid, that the drop in potential when r_0 is approximately 0.001 mm. does not exceed 13 millivolts, even at such low cathode overvoltages as are obtained with nickel. The experiments showed that in every case when the drop in potential through the electrolyte is too large to be neglected it is also necessary to allow for changes in the concentration of the electrolyte at the cathode surface. The potential drop at the cathode, even in microcells of the kind involved in acid solution of metals, is limited by the acid and dissolved salt concentrations at the cathode as long as the electrolyte at the cathode surface remains acidic. When the relation between cathode overvoltage and anode potential becomes such that hydrogen can be evolved at the cathode even in alkaline medium this limitation disappears. In all cases of metals dissolving in acids for which there is any practical or commercial interest the current density at the cathode in microcells set up within the metal is always much less than 100 amp. per sq. cm.

Digest from "Ohm Resistance of Local Cells in Metals Dissolving in Acids," by V. G. Levich and A. N. Frumkin, *Zhurnal Fizicheskoi Khimii* **15**, 748-59, 1941. (Published in Russia.)

TESTING THINWALLED RUBBER GOODS

A METHOD has been developed for testing thinwalled dipped goods by measuring the height to which a test strip can be inflated when stretched over a tube under standard conditions, and the pressure at break. Specimens were tested when freshly made and after the customary accelerated aging test at 70 deg. C. Inflation height did not vary as much as pressure at break. Pressures even varied widely for goods from the same factory. Since pressure at break is more sensitive to aging than is inflation height the pressure data may be used alone as a first criterion of quality and aging resistance. Some typical results are shown in the table.

Digest from "Mechanical Testing of Thinwalled Dipped Goods," by P. Kluckow, *Kautschuk* **17**, 62–4, 1941. (Published in Germany.)

AMMONIA AND CYANIDE

BY EXPOSING gases from coal distillation to a high frequency arc discharge it is possible to produce hydrogen cyanide and ammonia. The gas contains about 9 percent nitrogen, which is chemically activated by the arc. From the power standpoint the yield of hydrogen cyanide is 16-17 gm. per kwh. in a high frequency arc (10,000,000 cycles per sec.) at atmospheric pressure or 20-25 gm. per kwh. in vacuum (45 mm.) after nitrogen enrichment of the gas to 30-50 percent. The yield is much lower in a low frequency arc (50 cycles per sec.) or without nitrogen enrichment. The ammonia which is produced at the same time is much smaller in quantity.

Digest from "Production of Hydrogen Cyanide and Ammonia from Coal Gas in a High Frequency Arc," by E. Briner and H. Hoefer, *Helvetica Chimica Acta* **24**, 1006-10, 1941. (Published in Switzerland.)

PROTECTING STRUCTURAL STEEL

IF STEEL is erected in a climate so favorable that a service life of thirty years may be expected, there would be no economy in painting it for protection. But if there is a choice between painting and allowing extra thickness for corrosion the economy of protection soon becomes apparent. Thus, in a climate which will corrode ⅛ in. from the total thickness of an exposed plate in ten years, the extra thickness allowed for corrosion would increase initial cost about 25 percent. Hence replacement after ten years would mean annual depreciation of 12.5 percent of the initial cost for thinner (protected) steel. Superstructures lost during replacement may fairly be represented to add a like amount, raising the annual depreciation rate to 25 percent. As against these figures, optimum use of paint to prolong service life to thirty years would bring the annual depreciation rate down to about nine percent after allowing for the cost of painting and maintenance.

Typical results of breaking tests on dipped rubber goods

	Aged 7 days at 70 deg. C.		Aged 14 days at 70 deg. C.			
	Height at break	Pressure at break	Height at break	Pressure at break	Height at break	Pressure at break
Specimen	cm.	cm. Hg	cm.	cm. Hg	cm.	cm. Hg
A1	18.9	7.8	15.5	2.0	destroyed	
B2	19.6	12.0	17.2	2.8	14.4	1.0
C8	18.7	8.5	17.7	3.9	15.0	0.7
D9	18.9	10.0	17.1	3.3	14.5	1.0
E13	21.7	12.2		destroyed		
F14	17.3	4.3				
G15	18.5	8.9	18.8	6.6	19.2	4.6
H17	18.3	5.6	18.8	3.3	destroyed	
I18	19.3	12.4	18.0	1.4	15.0	0.8
K19	19.7	12.9	20.0	17.3	2.3	15.7

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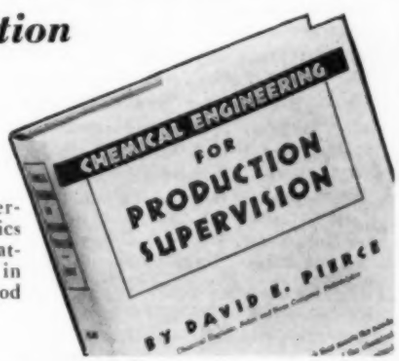

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Initial good painting without any subsequent maintenance effects a saving as compared with using heavier unpainted steel, but would mean a higher annual depreciation rate than good painting properly maintained.

Digest from "Corrosion and Protection of Structural Steel", by A. M. G. Dempster, *Engineering* **153**, 17–8, 1942. (Published in England.)

POWER FROM SULPHITE WASTE LIQUOR

To use sulphite waste liquor as fuel is not thermally efficient since it takes 2,500 cal. per kg. of product to evaporate the liquor down to a high ash fuel yielding only 3,500 cal. per kg. But the Baur method of setting up an electrical system for deriving energy from oxidation of coal to carbon dioxide is also applicable to waste sulphite liquor. It is necessary to set up an electromotive system in which 2 processes proceed at the electrodes, namely:

$$3O_2 + 6H_2O + 12\ominus = 12OH^-$$

$$2(C\text{-}H_2)_{L\cdot SO_3H} + 12OH^- + 12\oplus = 2CO_2 + 8H_2O$$

$$2(C\text{-}H_2)_{L\cdot SO_3H} + 3O_2 = 2CO_2 + 2H_2O$$

This equation represents the ideal reaction by which ligninsulphonic acid would be oxidized to CO_2 and H_2O, a result which would not be achieved in practice. It is probable that power could be profitably generated since a yield of 1.3 kwh. per kg. of sulphite liquor should cover production costs under present (German) conditions. German production of sulphite pulp would provide enough waste liquor to yield about 2,000,000,000 kwh. annually.

Digest from "Sulphite Waste Liquor as a Source of Energy," by K. Schwabe, *Papier - Fabrikant* **39**, 129-32, 1941. (Published in Germany).

SOLUBILIZING ALUMINA IN KAOLIN

Heat treatment solubilizes alumina in kaolin sufficiently to permit acid extraction. When 20.2 percent HCl or 20 percent H_2SO_4 was used as solvent the proportion of soluble alumina was about the same, but when a weak acid such as H_2SO_3 is compared with a strong acid a considerable difference is observed. Maximum conversion of alumina in kaolin to the soluble form is achieved better by slow mild heating than by rapid intense heating. The adsorption capacity of kaolin, as well as its soluble alumina content, is influenced by heat. Heating in oxygen causes agglomeration and is undesirable for adsorbents. But if kaolin is heated in a current of HCl gas the product is fluffy, has a high tapped volume and does not cling to the furnace walls. Adsorption capacity for

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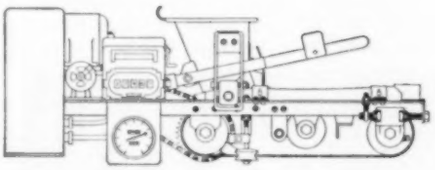

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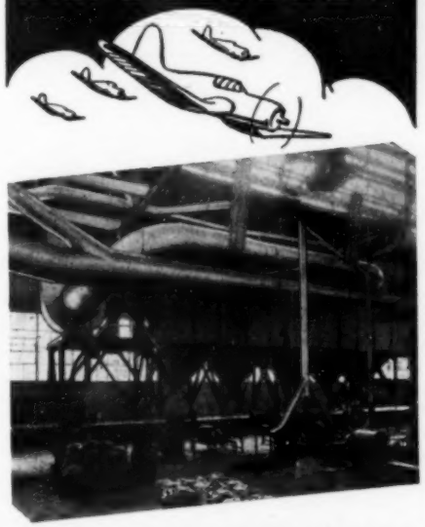

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methanol vapor is about twice that of kaolin heated in air under the same conditions.

Digest from "Solubilizing the Alumina in Kaolins by Preheating in Gases Other Than Air," by G. F. Huttig and E. Herrmann, *Zeitschrift fur Elektrochemie* **47**, 282-6, 1941. (Published in Germany.)

ACETYLENE FROM COAL GAS

ILLUMINATING gas, containing CO 21.2, H_2 47, CH_4 17, N_2 9 and higher hydrocarbons 2.4 percent, yields acetylene when exposed to a high frequency arc discharge. It is necessary to operate in vacuum (below 200 mm. pressure) to avoid fouling the electrodes with soot formed by carbonizing the hydrocarbons. The yield of acetylene is improved by spacing the electrodes well apart, with correspondingly low current density. Thus, with electrodes 15 mm. apart the current density was 115 mA. and the yield of acetylene was 105.5 gm. per kwh. With electrodes 25 mm. apart and proportionately lower current density the precision of the measurements was less, but as a rough approximation the yield rose to 180 gm. per kwh. Copper electrodes were used in most of the experiments but some tests were made with aluminum electrodes, which give a more stable arc.

Digest from "Making Acetylene from Coal Gas in a High Frequency Arc Discharge," by E. Briner, J. G. de Werra and J. P. Jacob, *Helvetica Chimica Acta* **24**, 1010–3, 1941. (Published in Switzerland.)

PIEZO QUARTZ CRYSTALS

OF ALL the many crystalline substances which have piezoelectric properties only rochelle salt, tourmaline and quartz are suitable for commercial use. Tourmaline is little used because the crystals are scarce and expensive. Rochelle salt crystals can be prepared as required, but quartz is particularly useful as a source of large crystals from which slabs, rings, plates, bars or rods can by cut to meet specific requirements. Resonators and oscillators containing piezoelectric quartz are useful in depth sounders, submarine detectors, directional submarine signal devices, radio apparatus, range finders, direction-reading seismographs, periscopes, gunsights, and other instruments. Twinned quartz crystals are unsuitable because they are not piezoelectric. It is also necessary to reject some crystals because of electric twinning which is about as common as optical twinning but cannot be detected until the crystal is tested for piezoelectric response. It destroys the asymmetry and hence the electrical response of the crystal. True piezoelectric quartz crystals are mostly imported from Brazil but they occur in many places. They also find applications in optical goods, scientific instruments and fused silica ware. Hence there are other outlets for crystals which are not piezoelectric.

Digest from "Piezo Quartz," by Alfred W. G. Wilson, *Canadian Chemistry and Process Industries* **26**, 10–4, 45, 1942. (Published in Canada.)

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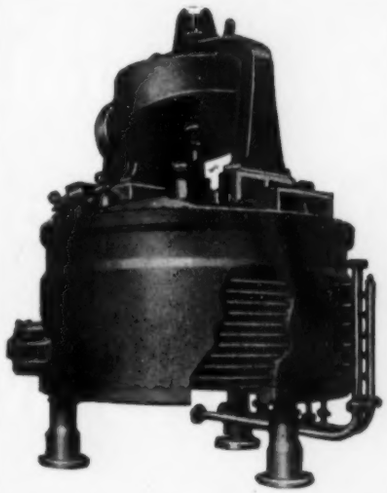

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New Titles, Editions and Authors

CHEM & MET BOOKSHELF

WIB vs. WPB

AMERICAN INDUSTRY IN THE WAR. A Report of the War Industries Board by *Bernard M. Baruch*. With an introduction by *Hugh S. Johnson* and edited by *R. H. Hippelheuser*. Published by Prentice Hall, Inc., New York, N. Y. 491 pages. Price $5.

Reviewed by *S. D. Kirkpatrick*

THOSE on the chemical front who fought even a part of the Battle of Washington in 1917-18, will find this reprint of Mr. Baruch's famous 1921 report of the War Industries Board an interesting reminder of earlier tussles with shortages, priorities and price fixing. For those who are immediately concerned with today's problems, this book should prove a valuable record of experience—a helpful guide to avoid some of the obstacles that still lie in the path of industrial mobilization.

As we tried to point out in an editorial some months ago, (see *Chem. & Met.* January 1942, p. 77-8), the chemical situation is vastly different today. We now have a greater and more resourceful chemical industry. We have profited from the earlier experience by preventing disastrous inflation of prices that, for example, permitted sulphuric acid to jump from $14 a ton to over $60 early in the war. We have been able to meet the present war's major challenges, despite the pyramiding of demands arising from short-sighted planning.

Yet one cannot read the chapter on "Chemicals for Munitions" or the related commodity sections without realizing the very important part that our industries played in the strategy of the first World War. The late Leland L. Summers, who directed the Raw Materials Division and gave most of his personal attention to chemicals, was Mr. Baruch's right-hand man in all his thinking and planning. MacDowell, Chase and the score of other chemical executives and engineers got results because their problems were clearly understood by and aggressively presented to the top councils of the War Industries Board. And the record, as we read it after 20 years, is nothing to be ashamed of—considering the difficulties that had to be met with a new and untried industry.

It is unfortunate that more of the lessons of the 1918 experience could not have been applied to our whole program of industrial mobilization. Strangely enough we had to follow the same path and make the same mistakes. Now, after many months of conflict and confusion, we have finally arrived at the centralization of authority and responsibility that Mr. Baruch urged so eloquently. Let us hope that it is not too late to do the job. This book will help all of us. It is a reference source as well as a factual history of valuable experience. It includes in addition to the WIB report, a well edited version of Mr. Baruch's own program for industrial mobilization as he presented it to the War Policies Commission in 1931. Finally, there is enough current material on priorities and price fixing to give the industrial executive the proper background to understand and anticipate the further wartime trends in the relations of government to industry.

FOR DEFENSE TRAINING COURSES

CHEMICAL ENGINEERING FOR PRODUCTION SUPERVISION. By *David E. Pierce*. Published by McGraw-Hill Book Co., New York, N. Y. 232 pages. Price $2.50.

Reviewed by *William T. Dixon*

IN THE preface, the author states that the book is "Presented with the hope that it will meet the need of non-technical operating men for a simple explanation of the equipment for which they are responsible." He has accomplished his purpose by careful choice of subject matter and the inclusion of many illustrative problems carried out in sufficient detail so that supplying missing steps is unnecessary.

The first chapter, General Principles of Chemistry and Physics, supplies the fundamental information necessary "for an understanding of the succeeding chapters." Transformation of Energy, which follows, covers calculations "involving energy in its various forms." The other chapters discuss five of the more important unit processes, heat transfer, evaporation, distillation, drying and flow of fluids. The discussion and the mathematical treatment have been kept as simple as possible and yet all essential information has been included. Each chapter contains in addition to descriptive material, methods of calculation and illustrative problems, a rather complete list of problems for the student to solve. The 110 problems at the end of the first chapter range from the calculation of the molecular weight of methane to the pull on the anchor rope of a Zeppelin. Several useful tables are included in the appendix.

The main use for this book will undoubtedly be as a text in the training of the non-technical men of the chemical industry. It was in the course of actual work of this kind that the book was developed by the author. For this use, the book seems admirably designed, containing an excellent balance between descriptive matter, theory and problem material. A thorough use of the problem material will give mastery of the use of the data and method of calculation presented which, after all, should be the main aim of the student.

In a less formal way the book can be used by the non-technical man trying to understand the basic principles behind the operation of his equipment, provided that he has access to some technical guidance.

The book is highly recommended to the non-technical men of our chemical industry who are interested in the "whys" and the "wherefores" of their operations.

CHEMICAL ENGINEERING

INORGANIC CHEMICAL TECHNOLOGY. Second Edition. By *W. L. Badger* and *E. M. Baker*. Published by McGraw-Hill Book Co., New York, N. Y. 237 pages. Price $2.50.

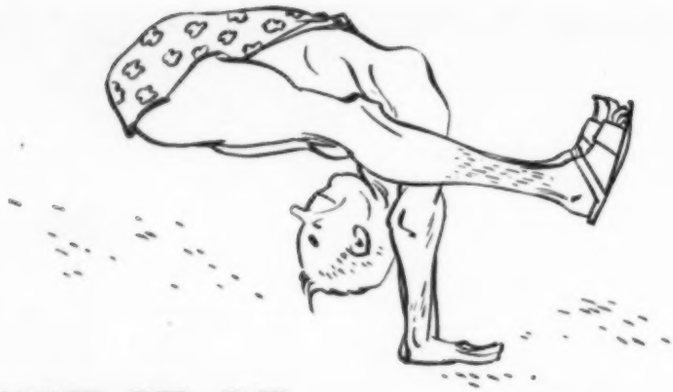
Reviewed by *Charles O. Brown*

THIS new edition of the original book by the same name is written purposefully, as was the first edition, for use as a chemical text. In this regard it has excellent composition and characteristics and is an important modernized improvement over the first edition, now 14 years old. The number of pages has been slightly increased, but an important addition is a 20 percent increase in the index. The chapters have been decreased from nine to eight and revised with beneficial results.

Owing to the exceptional experience of the authors, particularly Dr. Badger, the chapters on salt and such portions of the book as treat with evaporation, sodium compounds and the preparation of alkalis, deserve only favorable comment. As a textbook there are indications that the student is expected to have a good working knowledge of the principles of chemical engineering. For example, in the problems following the chapter on salt, one suggested is to check the coefficient of heat transfer from data given in Table 6 which refers to the operation of a salt grainer. From the data given, considerable judgment of heat transfer practice must also be used.

The chapter on sulphuric acid is an excellent text for a brief presentation of this important material, with new flowsheets and a commendable section on acid concentration. Each chapter in the book is supported by good representative references. The references are not keyed into the text in all the chapters.

The subject of fixed nitrogen and nitric acid in which the authors have included important data on sodium



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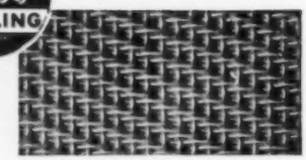

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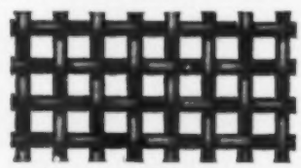

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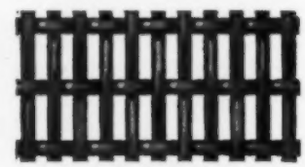

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nitrate, is becoming such a big and important industry that it is a difficult task to present this subject intelligently and effectively in 32 pages, but the authors have done exceptionally well in this section. There are minor conclusions, data and flowsheet details which might be questioned, but on the whole the chapter is concise and satisfactory. One could wish that in a new edition such an old art as the manufacture of calcium carbide could be "opened up" a little rather than to give authoritative documentation to the antiquated types of equipment which unfortunately are still in use. The paragraph devoted to calcium carbide fortunately omits sufficient detail so that the student is not reminded of the fact that the furnaces of the company named in the text are still open-top, free-burning and hand-fed. There is nothing very modern concerning these furnaces except the size. On the other hand, in a textbook on inorganic technology we question the advisability of prophesying that no more cyanamide plants will ever be built in the U. S. The text properly states that the cyanamide process for the production of ammonia is hopeless, but in view of the widely useful and diversified products which will be made from dicyanamide it is just possible that the U. S. might see a new cyanamide project.

The chapter on hydrochloric and phosphoric acids has been re-written giving important space to the use of tantalum for hydrochloric acid absorption and the electric furnace methods for the production of phosphoric acid and phosphates.

The chapter on soda ash has been rewritten and improved.

One of the more pleasing sections of this second edition is the chapter on caustic soda, which now includes chlorine. The cells discussed have been changed to the Vorce cell and the Hooker Type S cell; two of the most important diaphragm cells at the present time. The mercury cell is making somewhat better progress than the authors imply.

The chapter on miscellaneous products has also been improved, but like the book as a whole, it is still kept within a reasonable length to best serve as a text. The reviewer recommends replacing the first edition with this second edition.

PRINCIPLES OF PHYSICAL METALLURGY. Second edition. By *G. E. Doan* and *E. M. Mahla*. Published by McGraw-Hill Book Co., New York, N. Y. 388 pages. Price $3.50.

THREE subdivisions cover the subject of physical metallurgy in this revised edition. They are: the physics of metals, metallography, and metal technology. Among the subheadings which have been revised in the light of recent advances and which may be of interest to chemical engineers are the discus-

sions of creep and fatigue, age hardening, welding, and powder metallurgy. The book is still primarily a textbook, nevertheless it would serve admirably as a reference or as a source of information on some of the more recent developments in physical metallurgy.

THE GLASS ELECTRODE, METHODS, APPLICATIONS AND THEORY. By *Malcolm Dole.* Published by John Wiley & Sons, New York, N. Y. 332 pages. Price $4.50.

Reviewed by *G. A. Perley*

THIS monograph is one which should be in the hands of every physical chemist who is interested in hydrogen ion potentials. It presents a collection of most of the important material related to the use of the complete glass electrode system. The presentation is so arranged and subdivided that it is possible to select specific subject matter without searching through pages of less desired information. In general the material is well arranged, but some outstanding exceptions should be pointed out.

The beginner who reads on page 17 "In Eq. 2.1.5 the pH is not the 'theoretical pH' of Eq. 2.1.2 but pH as calculated by Eq. 2.1.5 from measurement" should not have to wait until he reaches pages 303 for the statement, in the sentence "The pH function is not one which lends itself to exact thermodynamic definition in terms of the composition and concentration of the solution: it can only be defined in terms of electromotive force."

It appears to the reviewer (who may be biased) to be unfortunate that the author did not avail himself more widely of the wealth of information in the possession of the manufacturer of pH equipment. The footnotes make frequent reference to private communications from one company to the exclusion of most others. As a result there are erroneous statements in the text and mistakes in figures which might readily have been avoided. For example, in Fig. 3.7 C of page 48, it would have been easy to get the facts which would have shown that the RH 507 was used as a plate control tube. Again on page 49, in the Cherry circuit the resistance R_s+R_e more nearly approximates 14,500 than 2,500 ohms, giving an approximate plate current of 85×10^{-6} amp. In the same connection the statement that "a resistance of 5 megohms is inserted to prevent polarization of the unknown cell during the emf measurements" is misleading. The statement on page 22 that the antimony-antimony oxide electrodes "are relatively unimportant" would probably not have been made if the author had been informed of how many hundreds of recording or automatically controlling antimony electrodes are in use in industry.

In the discussion of Galvanometer Potentiometer Circuits in 3.2 no mention is made of the low resistance glass

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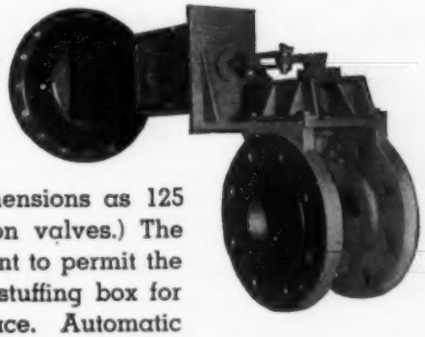

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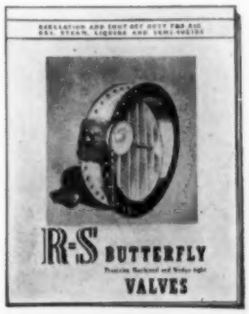

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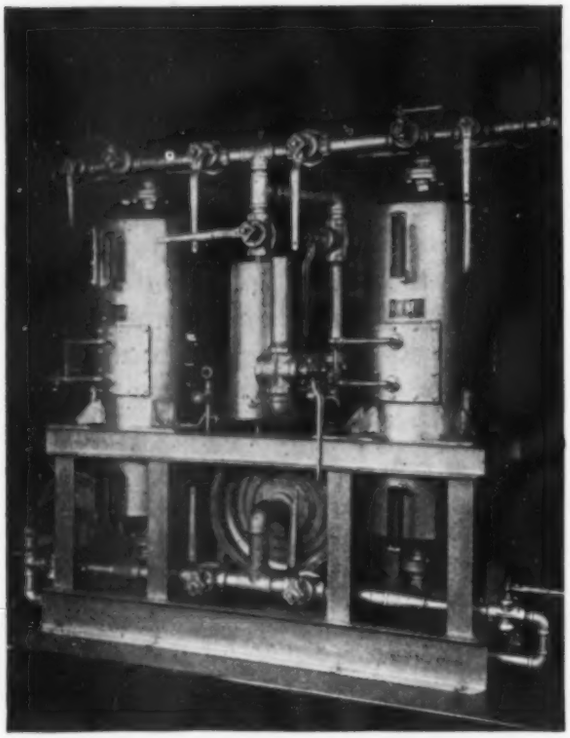

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electrode equipments made available by the Leeds & Northrup Co. beginning with 1932. Thousands of these low resistance glass electrodes are in service.

It is natural to expect in the first edition of a monograph of this scope that there would be some statements which would not meet the approval of all readers. It is unfortunate that the technique for the hydrogen gas electrode as presented on pages 15-18 is designed for the most refined research methods. As a matter of fact, where a limit of error of 0.0012 volt (approx. 0.02 pH) is involved, the average industrial chemist should be informed that it is possible to set up a very simple hydrogen gas electrode system. It is unfortunate that in the comparison of the various electrode systems someone has not discussed the case of the vast majority of measurements where a limit of error of ± 0.003 volt (approx. 0.05 pH) is amply good.

In 9.8 on pages 165-168 it is not easy for the less informed to follow the story relative to the temperature coefficient of the saturated calomel reference electrode. Thus if we take the information of table 9.5 on page 166 for the E° values at 0 deg. C. and at 60 deg. C. for the saturated calomel electrode we would come out with a $\Delta E/\Delta T$ value of -0.000671 volt. However, on page 166 the temperature coefficient of the saturated calomel half cell as found by Cary and Baxter was given as 0.20 mv. per deg. C. at 25 deg. C. Nothing is mentioned as to the sign of this. It is unfortunate that a clearer presentation was not made by which one could come to the conclusion made long ago by W. M. Clark "Thus it comes about that the absolute temperature coefficient for the saturated calomel half cell is low and positive while by the standard of reference it is high and negative." The absolute temperature coefficient of the saturated calomel half cell is of the order of $+0.00025$ volt and it is important to know when this value rather than the relative value is to be employed.

Chapter 13 on continuous pH recorders and automatic pH control does not present a good picture of the situation as it exists in the United States today. It is true that much of the industrial recording technique has been gradually built up through years of experience on the part of certain instrument manufacturers and that many details are not easily available. This chapter in its present form could well have been omitted.

SOLUBILITIES OF ORGANIC COMPOUNDS. Third Edition, Vol. II. Compiled by *Atherton Seidell*. Published by D. Van Nostrand Co., New York, N. Y. 926 pages. Price $10.

THIS volume is the companion to "Solubilities of Inorganic and Metal Organic Compounds" which appeared during 1940. The second edition of

the complete work appeared in 1919 and a supplement was issued in 1928.

In this volume the compiler deviated from his previous practice and has listed the organic compounds in accordance with their increasing content of carbon, hydrogen and oxygen instead of alphabetically. To provide an additional means of locating compounds, a cross-reference name index has been placed at the end of the volume. In order to prevent costs from becoming prohibitive, the text has been produced by offset printing.

It is hardly necessary to praise such a well-known, authoritative and indispensible reference work. Suffice it to say that the book is more comprehensive than ever and retains all its marks of excellence. During the next depression, when time will not command such a premium, perhaps someone will make a study of the chemical research-hours saved through the use of Seidell as compared to certain labor-saving laboratory instruments. The results would probably lead to a more healthy respect for the reference book.

AIR RAID PRECAUTIONS. Published by Chemical Publishing Co., Brooklyn, N. Y. 280 pages. Price $3.

Reviewed by *J. R. Callaham*

TEN British government publications are reproduced in this book. They represent the present British practice and contain excellent suggestions, but may confuse uninitiated Americans who know nothing of the subject and who intend to learn the fundamentals of protection from enemy air raids. There is no introductory material and the very first chapter starts at once on the subject of rescue parties and clearance of debris. However, the book is valuable in that it makes readily available in this country the experience and advanced knowledge of the British on the subject.

There are two chapters in the book which are excellent. They are "Structural Defense" and "Protection of Windows in Commercial and Industrial Buildings." The first contains detailed engineering data on high explosive bombs, effects of detonation, penetration of steel and other materials, cratering, bomb-proof shelters, shelter requirements, design of new buildings and modifications of existing structures. The second, concerned with protection of windows and roof lights in industrial buildings, gives drawings and specifications for protection from both near and distant effects, including various kinds of blocking, light weight shutters and screens and adhesive treatment of glass. Information in this chapter is essentially the same as that on the subject new being distributed from Washington through the Office of Civilian Defense.

Plant engineers will find the above two chapters of considerable value in adopting protective measures against enemy air raids and high explosive bombs. Unfortunately, one of the shortcomings of the book is the fact that it

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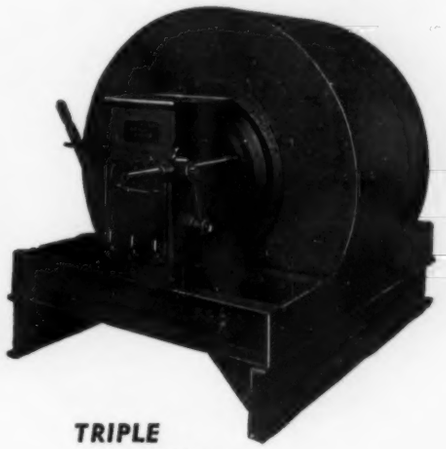

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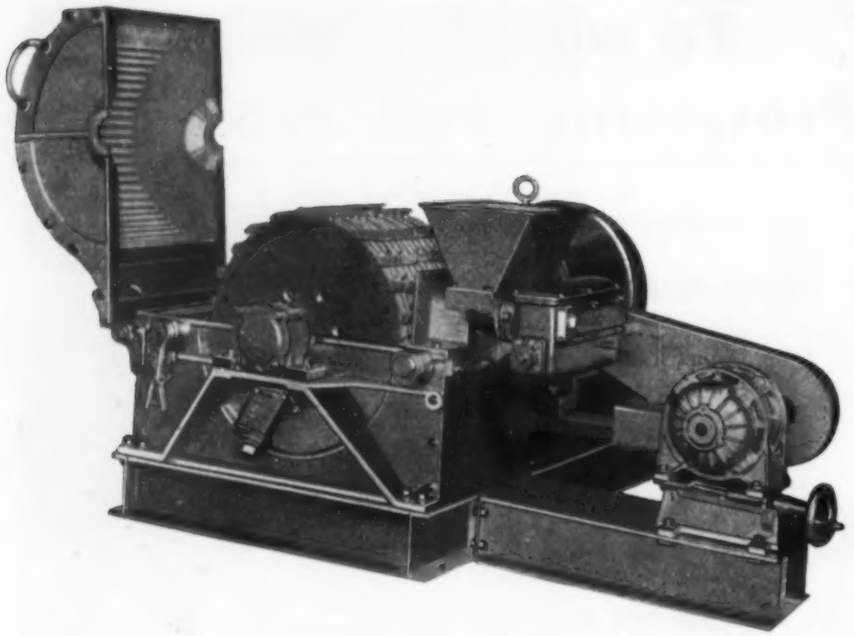

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contains no information on magnesium or other incendiary bombs and their extinguishment.

Other chapters, intended primarily for civilian organization and training, are entitled "Organization of Decontamination of Services," "Organization of the Air Raid Wardens' Service," "Local Communications and Reporting of Air Raid Damage," "Notes on Training and Exercises," "Gas Detection and Identification Service," "Inspection and Repair of Respirators and Oilskin Clothing," and "Care and Custody of Equipment."

AERIAL BOMBARDMENT PROTECTION. By *Harold C. Wessman* and *William A. Rose*. Published by John Wiley & Sons, Inc., New York, N. Y. 372 pages. Price $4.

MOST people now agree that the cities of this country are exposed to enemy air attacks which may not be long in coming. Few now believe that such attacks will be or can be frequent, sustained or on a large scale. However, many people have not yet realized that America's immunity from surprise attack by air is gone forever. Fifteen or twenty years from now, when the times will probably be ripe for another conflict and the war plane will be highly perfected, it is easy to conceive that New York or San Francisco will be as vulnerable from the air as was Warsaw in 1939 or London in 1940. It is with this immediate and long-term viewpoint that the authors deal with the structural problems involved in protection from aerial bombardment.

Since 1940 the authors, members of the Departments of Civil and Structural Engineering at New York University, have offered courses in cooperation with the Engineering Defense Training Program of the U. S. Office of Education on the subject of aerial bombardment protection. This book is the result of the expansion of these lecture notes. Although much of the basic information on the action and effect of aerial bombs was obtained from the British air raid precautions publications, the authors have done meritorious work on adapting such information to American practice. Thus they have done a double service; making easily available to Americans the extensive experience of the British, and translating this experience into terms of American construction.

In brief, the book is primarily devoted to a detailed discussion of those measures which can and should be undertaken to make building construction bomb-resistant at reasonable cost. The term "bomb-resistant" rather than "bombproof" is used as it is now understood that relatively few structures can be made bombproof and that even these few may at some future time be destroyed completely with the more powerful bombs which scientists and engineers will undoubtedly develop. Although the treatment is of a technical nature and intended primarily for engineers and architects, the material has been presented in such a way that the greater part may readily be com-

prehended by the interested layman.

A chapter on the fundamentals of structural engineering properly introduces the subject to the reader, after which there follows an anaylsis of the new problems of structural design created by the impact and energy loads of aerial bombs. After discussing the details of the various bomb types and their characteristics, the authors give interesting data on the trajectory of bombs, accuracy of aerial bombardment, penetration and perforation and the phenomenon of scabbing. There follows a technical analysis of the impracticability of designing for protection against the impact of direct hits and a discussion of designing structural units to resist the high energy values of aerial bombs. Details of the sequence of blast, shock and fragmentation are next given, followed by data on the design of wall panels to resist blast.

An interesting analysis is given on aerial bombardment damage in foreign countries. The authors then evaluate basic factors and materials commonly used in building construction in the light of both the old and the new problems. Their analysis of building requirements, dealing specifically with wall construction, floors, exits, elevators and mechanical and electrical equipment, is thorough and practical. In applying these requirements and principles to specific building types, office buildings, apartments and public buildings, multi-story factories, warehouses, and one-story industrial buildings are discussed.

Another excellent section of the book includes the three chapters dealing with the analysis of air raid shelter requirements, shelter zones in existing buildings, and special shelters. These chapters include information on basic and special considerations governing design, shelter zones in skyscrapers, industrial buildings and dwellings, domestic and public shelters, design of dual-purpose shelters, and industrial and commercial shelters. The chapter on protective concealment deals with fundamental considerations, properties of surfaces, basic problems in camouflage and camouflage practice. A final section deals with the vibration of structures in relation to explosive effects and to the Edgewood Arsenal series of tests on the effect of aerial bombs on various types of structures and structural materials.

Wessman and Rose have done a good job. So have the publishers. The book is sturdy in binding and represents good typography. The subject matter is well organized, adequately indexed and illustrated by photographs, diagrammatic sketches, charts and tables. The numerous reference footnotes indicate the thoroughness with which the literature on the subject has been covered. The book is undoubtedly an excellent digest of present knowledge and experience and is the outstanding American contribution to the literature on the new and important science of structural protection from aerial bombardment.

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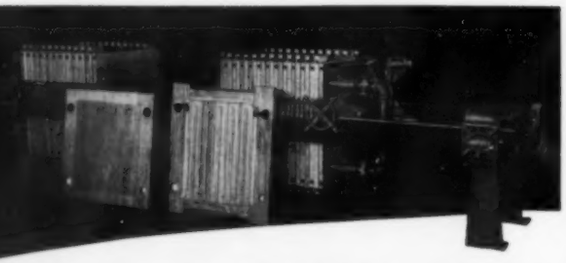

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RECENT BOOKS and PAMPHLETS

Researches on the Structure of Alloys. By *W. Hume-Rothery.* Published by British Non-Ferrous Metals Research Association. London. 20 pages. Price $.50. Contains the plan, aims and main conclusions of the work which Dr. Hume-Rothery has been carrying on during more than 15 years and the detailed results of which have been published elsewhere. A list of the published papers mentioned is appended to the report.

State Fertilizer Laws. An extensive chart giving "a summary of State fertilizer control laws, regulations, and rulings, as of January 1, 1942" has been prepared by National Fertilizer Association. The chart is available to those requiring it without charge from National Fertilizer Association, Investment Building, Washington, D. C.

Paper Making Abstracts. Issued by the Technical Association of the Pulp and Paper Industry, New York, N. Y., 150 pages. Abstracts of articles and books relating to the manufacture and technology of pulp, paper, paper board and paper products. It is expected that the abstracts will be brought up to date in 1942 and thereafter will be furnished to TAPPI members on a quarterly basis. An index of abstract authors is included.

Theoretical Calculations for Explosives. Bureau of Mines Technical Paper 632. Available from Superintendent of Documents. 21 pages. Price 5 cents. Explosion temperatures and gaseous products and the effects of changes in carbonaceous material. First of a series of papers designed to show that even the admittedly inadequate theories that now exist will, if modified, yield valuable information on explosives.

Tests of Cylindrical Shells. By *W. M. Wilson* and *E. D. Olson.* University of Illinois Engineering Experiment Station Bulletin No. 331. 129 pages. A report of investigations conducted to determine the action of thin cylindrical steel shell when subjected to axial compression, transverse shear and flexure, singly or in combination. Tests were made on small machined specimens and large fabricated ones.

Subcontracting for Defense. Published by Policyholders Service Bureau, Metropolitan Life Insurance Co., New York, N. Y. A study prepared in the interest of stabilizing employment. Outlines the methods followed by 28 companies in meeting the problems of prime contracting or subcontracting. Includes sections on obtaining prime contracts, sources of information on governmental requirements, and administration of and responsibility for subcontracting in the prime contractor's organization.

The Commercial Market for Pearlitic Malleable Cast Iron. By *D. L. Boyes.* Published by Massachusetts Institute of Technology, Cambridge, Mass. 82 pages. First of a series of publications which will make available the results of an investigation of a practical business problem by a competent investigator of from 5 to 10 years' industrial experience. Scope of the study was quite broad including commercial uses and applications, potential market, present commercial production, and a collection of authoritative opinions on the commercial future for pearlitic malleable cast iron.

American Cotton Handbook. By *G. R. Merrill, A. R. Macormack* and *H. R. Mauersberger.* Published by American Cotton Handbook Co., New York, N. Y. 1,024 pages. Price $4.80. A consolidation of the latest practical information on historic, economic, social, technical as well as chemical phases of the cotton growing manufacturing and processing industry in America. Contents are divided into 23 chapters, there is a 770-word glossary, an appendix is included on the nomenclature of dyes and there is a 24-page index.

A.S.T.M. Standards on Rubber Products. Published by the American Society for Testing Materials, Philadelphia, Pa. 280 pages. Price $1.75. December, 1941, edition of the annual publication giving the latest A.S.T.M. approved specifications and methods of test. In addition, it includes a useful bibliography of sources of information concerning the properties and testing of rubber.

Possible Alternates for Nickel, Chromium and Chromium-Nickel Constructional Alloy Steels. Published by American Iron and Steel Institute, New York, N. Y. 143 pages. Price 50 cents. Alternates suggested by this booklet embrace a series of carbon-molybdenum steel, manganese-molybdenum steel, and also low chromium-molybdenum and low nickel-chromium-molybdenum steel. To develop the series of new steels, the responsible committee devised untried chemical compositions, melted experimental sheets, tested, and selected those which seemed suitable. The booklet contains a multitude of graphs of comparative physical properties, tensile strengths, hardenability, and other experimentally determined values. Use of the alternate steels may make necessary some changes in established methods of fabrication or heat treatment procedures or both, or may even make necessary some changes in engineering design of the product affected.

How to Check Inflation. By *John M. Clark.* Pamphlet No. 64 published by the Public Affairs Committee, Inc., New York, N. Y. 31 pages. Price 10 cents. In simple language, this booklet points out why we have inflation and what should be done about it. Contains a warning that further serious inflation is inevitable unless prompt and vigorous action is taken to restrain it.

How to Stop Inflation. Published by Office of Price Administration, Washington, D. C. 10 pages. Similar in scope to the pamphlet mentioned above, this pamphlet explains in non-technical language the forces making for inflation, measures taken against inflation in other countries, the effect of inflation, and what can be done in this country to prevent it.

The Chemical Age Year Book, 1942. Published by Benn Bros., Ltd., Fleet St., London. 134 pages. Somewhat smaller, but containing more pages than last year's edition, this yearbook contains the same type of material for the guidance of British buyers of equipment and chemicals. Several pages of physicochemical tables and lists of reagents and indicators have been included.

Heat Transfer to Clouds of Falling Particles. By *H. F. Johnstone, R. L. Pigford,* and *J. H. Chapin.* Bulletin 330, University of Illinois Engineering Experiment Station. 55 pages. Price 65 cents. Report of an investigation undertaken for the purpose of obtaining information essential to the design of equipment for heating finely divided material falling through a gas. Immediate object of the work was the design of a flash calciner for the decomposition of hydrated zinc sulphite, the product of one operation in a cyclic process for the recovery of sulphur dioxide from waste gases. Considerable theoretical treatment is included.

Refractories—The Backbone of Industry. By *John D. Ramsay.* Published by North American Refractories Co., Cleveland, Ohio. 115 pages. A history of the refractories industry including discussions of processing, technology, sales methods, economics, as well as the selection and care of refractories. One chapter discusses the North American Refractories Co., its history, development and products.

Accounting for Special Reserves Arising Out of the War. Accounting Research Bulletin No. 13 issued by American Institute of Accountants, 13 E. 41st St., New York, N. Y. 8 pages. Primarily concerned with the problem of properly showing special war reserves in financial statements, the bulletin lists 11 purposes for which reserves may or must be provided. It stresses the fact that, owing to uncertainty as to duration of the war period, it is difficult to determine amounts of possible costs and losses. Recommendations are made for the accounting treatment of special war reserves.

Iron Men and Their Dogs. By *F. G. Latrobe.* Published by the Koppers Company, Bartlett-Hayward Division, Baltimore, Md. 225 pages. Portrays the growth of "Bartlett-Hayward" from cook stoves, cast iron and water heating boilers to massive reclamation project castings, high tensile bronze, and gigantic modern gas holders. The story covers more than 100 years of progress and growth. The "dogs" referred to in the title are two cast iron replicas of the primogenitors of the Chesapeake Bay dogs which have been the talisman under which Bartlett-Hayward has made all its progress.

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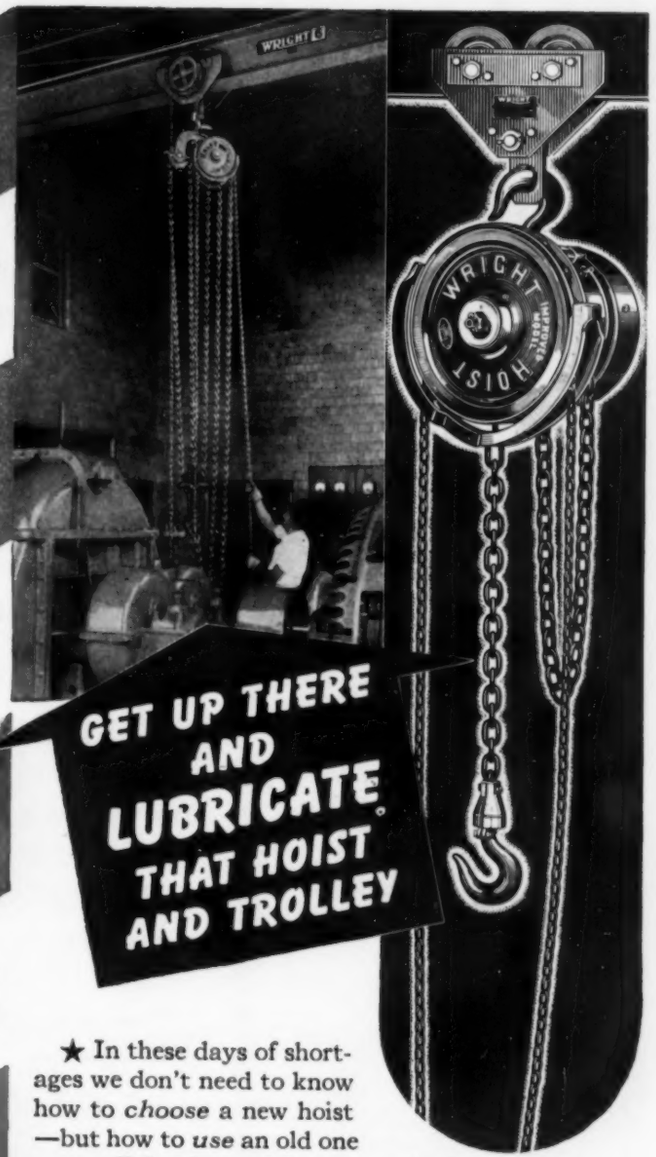

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GOVERNMENT PUBLICATIONS

The following recently issued documents are available at prices indicated from Superintendent of Documents, Government Printing Office, Washington, D. C. In ordering publications noted in this list always give complete title and the issuing office. Remittances should be made by postal money order, express order, coupons, or check. Do not send postage stamps. All publications are in paper cover unless otherwise specified. When no price is indicated, pamphlet is free and should be ordered from Bureau responsible for its issue.

Determination of Types of Sulfur Compounds in Petroleum Distillates, by John S. Ball. Bureau of Mines Report of Investigations 3591; mimeographed.

Limits of Inflammability of Acrylonitrile in Air, by G. W. Jones, R. E. Kennedy, and G. S. Scott. Bureau of Mines Report of Investigations 3597; mimeographed.

Mercury Poisoning as a Mining Hazard, by Sara J. Davenport and D. Harrington. Bureau of Mines Information Circular 7180; mimeographed.

Inspection and Testing of Mine-Type Electrical Equipment for Permissibility, by L. C. Ilsley, E. J. Gleim, and H. B. Brunot. Bureau of Mines Information Circular 7185; mimeographed.

The Various B. T. U. Values of a Coal, by J. F. Barkley and L. R. Burdick. Bureau of Mines Information Circular 7193; mimeographed.

Crude Oil and Gasoline Pipe Lines in the United States, May 1, 1941, by G. R. Hopkins and F. S. Lott. Bureau of Mines Information Circular 7196; mimeographed.

Practical Fire-Sensitivity of Liquid-Oxygen Explosives Treated with Fire-Retardants. Bureau of Mines report of Investigations 3605; mimeographed.

Safe Opening and Determination of Construction of Detonators. Bureau of Mines Report of Investigations 3594; mimeographed.

Selenium Occurrence in Certain Soils in the United States, with a Discussion of Related Topics; Sixth Report, by H. W. Lakin and H. G. Byers. U. S. Department of Agriculture. 5 cents.

Methods of Extinguishing Magnesium Fires and Incendiary Bombs with very Hard Coal-Tar Pitch. Bureau of Mines, Pittsburgh, Pa.; mimeographed.

Monthly Mineral Reports. Each month the Bureau of Mines issues a statement regarding production or stocks or sales, as may be appropriate, of certain important minerals and metals. Those having urgent need for this information can receive these mimeographed statements direct from the Bureau on copper, lead, zinc, manganese, molybdenum, mercury, and iron and steel scrap.

Mineral Statistics. Preliminary review of operations in 1941 for the major metal and mineral industries have been issued by the U. S. Bureau of Mines in mimeographed "Mineral Market Reports." Each of the major metals and each of the major mining areas has been so reported.

Climate and Man. A bound volume of 1,248 pages constituting the Yearbook of Agriculture, 1941. $1.75. This Yearbook is the sixth in a series designed as a set of reference volumes for modern farmers dealing with all the important aspects of present-day agriculture in the United States. As in the other volumes, all the articles are summed up briefly in this introduction. Any reader who wishes to do so can get a view of the whole subject by reading the summary. For more details, he can then turn to particular articles in which he may be especially interested. As a further guide in helping the reader to pick out what interests him, each article has a short introductory statement below the title telling what it is about.

Agricultural Statistics 1941. This is the composite statistical summary published as a companion volume to the Yearbook (formerly these statistics were published in the Yearbook). Paper bound volume of 731 pages. 75 cents.

Annual Reports. Annual reports of each department, bureau, and independent establishment are being published currently during February. Those interested in the work of any particular bureau should address it asking for a copy of its annual report. These relate to the fiscal year ending June 30, 1941.

Arsenic in Natural Phosphates and Phosphate Fertilizers, by T. H. Tremearne and K. D. Jacob. U. S. Department of Agriculture Technical Bulletin No. 781. 10 cents.

Research and Progress in the Production and Use of Coal, by A. C. Fieldner and W. E. Rice. National Resources Planning Board, Technical Paper No. 4. 15 cents.

Occurrences and Uses of Dolomite in the United States, by Shirley F. Colby, Bureau of Mines Information Circular 7192; mimeographed.

Typical Analyses of Bituminous Coals Produced in District 1. Bituminous Coal Consumers' Counsel in cooperation with U. S. Bureau of Mines. 50 cents.

Information Bulletin No. 2. How Inventors can aid National Defense. National Inventors Council, U. S. Department of Commerce.

The Balance of International Payments of the United States in 1940. Bureau of Foreign and Domestic Commerce, U. S. Department of Commerce. Economic Series No. 17. 20 cents.

Changes in Import Duties Since the Passage of the Tariff Act of 1930. Cumulative Supplement. U. S. Tariff Commission. 45 cents.

Statistics on Alcohol. U. S. Treasury Department, Bureau of Internal Revenue, Alcohol Tax Unit; mimeographed.

Handbook of First Aid. Office of Civilian Defense. 10 cents.

Protection Against Gas. Office of Civilian Defense. 10 cents.

Training Auxiliary Firemen. Office of Civilian Defense. 10 cents.

How to Organize Civilian Protection in Your Community. Office of Civilian Defense. 10 cents.

The Gas Mask. War Department, Technical Manual 3-205. 144 pages. 25 cents.

Ordnance Safety Manual. Regulations governing the manufacture, storage, loading, and handling of military explosives and ammunition at establishments of the Ordnance Department, U. S. Army, Dec. 1, 1941. 221 pages. 30 cents.

Federal Specifications: These specifications cover purchasing by most Government departments, bureaus etc. New or revised specifications issued under Federal Standard Stock Catalog now available include the following, at 5 cents per copy unless otherwise indicated: TT-P-141, Paint, Varnish, Lacquer, and Related Materials; General Specifications (Methods for Sampling and Testing); 10 cents. P-D-236, Detergents, Special; (For Aluminumware, Dishwashing-Machines, and Manual Cleaning). P-S-616a, Soap, Toilet; Floating, White. C-G-463 Glue; Liquid. SS-C-201a, Cement; Portland, High-Early-Strength. SS-C-208a, Cement; Portland, Pozzolana.

Emergency Specifications: Emergency alternate Federal Specifications have been approved for the immediate use of all departments and establishments of the government, in order to conserve certain strategic materials. These specifications supersede those normally used in government buying. They are in mimeographed form and may be obtained from the Federal Catalog Division, Treasury Department, Washington, D. C. Typical recently issued emergency specifications are the following: E-TT-W-568, Wood-Preservative; Creosote-Petroleum Solution. E-TT-W-571b, Wood-Preservative; Recommended Treating Practice. E-UU-P-31a, Paper, General Specifications. E-TT-B-601, Bone-Black; Dry, Paste-in-Japan, Paste-in-Oil. E-TT-I-511, Indian-Red; Dry, Paste-in-Japan, Paste-in-Oil. E-TT-L-71, Lampblack; Dry, Paste-in-Japan, Paste-in-Oil. E-TT-O-111, Ocher; Dry, Paste-in-Japan, Paste-in-Oil. E-TT-P-31a, Paint; Iron-Oxide, Ready-Mixed and Semipaste Red and Brown. E-TT-P-61, Paint; Ready-Mixed, and Semipaste, Black. E-TT-P-81, Paints; Ready-Mixed, and Semipaste, Olive-Drab. E-JJJ-O-331, Oil; Linseed, Boiled. E-JJJ-O-336, Oil; Linseed, Raw.

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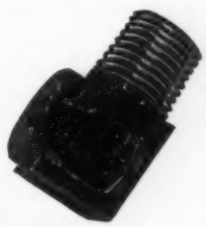

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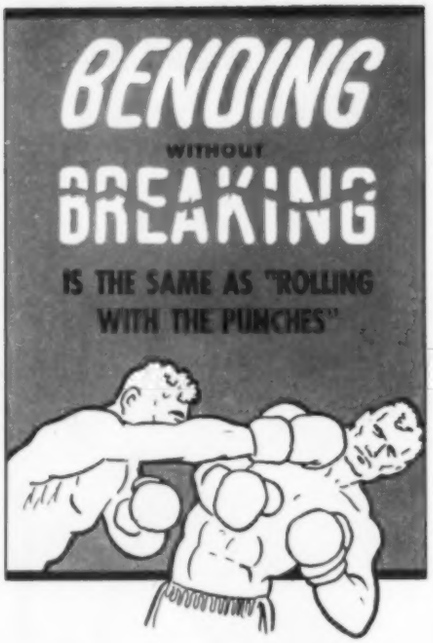

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MANUFACTURERS' LATEST PUBLICATIONS

Publications listed here are available from the manufacturers themselves, without cost unless a price is specifically mentioned. To limit the circulation of their literature to responsible engineers, production men and industrial executives, manufacturers usually specify that requests be made on business letterhead.

Alloy Steel. Worthington Pump & Machinery Corp., Harrison, N. J.—Form W350B48—12-page booklet giving technical information on this concern's "Worthite" improved acid-resisting alloy steel for the chemical and process industries. Includes information on general properties, analyses, electrolytic properties, laboratory and plant tests of corrosion resistance.

Ball Mills. Paul O. Abbe, Inc., 143 Center Ave., Little Falls, N. J.—Catalog T—54-page catalog on this concern's complete line of all-steel ball mills and pebble mills for wet and dry, batch or continuous operation. Contains suggestions on operation, basic grinding principles, graphic demonstrations of grinding action, information on mill construction and materials ground and mixed in the mills. Extensively illustrated by photographs and cross sectional drawings.

Bearings. The Timken Roller Bearing Co., Canton, Ohio—12-page publication which gives data on basic dimensions, rating and prices of 687 bearings put out by this concern. These bearings were selected from the company's line because they would readily fit into the military program, increase industrial output and speed up delivery.

Control Instruments. Leeds & Northrup Co., 4901 Stenton Ave., Philadelphia, Pa. — Catalog N95163 — 8-page catalog on this concern's simplified signalling controller for automatic testing of condensate purity in industrial steam plants. Contains photographs of the unit, diagrammatic sketches, mounting dimensions and other data.

Control Instruments. Mine Safety Appliances Co., Braddock, Thomas and Meade Sts., Pittsburgh, Pa.—Bulletin DB1—2-page folder which describes briefly and illustrates this concern's new continuous carbon monoxide recorder for precise measurement and recording of very low concentrations of carbon monoxide in air. Describes the instrument, its method of operation, and outstanding features.

Conveyors. Chain Belt Co., Milwaukee, Wis.—Bulletin 410—16-page catalog which deals with this concern's bulk handling conveyors of the belt and apron types. Contains brief descriptive material and extensive photographs of actual installations of the various units.

Crushers. Traylor Engineering & Mfg. Co., Allentown, Pa.—Bulletin 2105—14-page catalog on this concern's type "H" Blake jaw crusher. Includes a detailed discussion of the various parts of the unit, their specifications, and data on capacities, dimensions, assembly and erection, lubricating and repairing. Also Bulletin 1113—26-page catalog on the multi-stage fine reduction crusher put out by this concern. Includes information on general specifications, lubrication system, instructions for assembly, erection, operation and tables on the toughness of various kinds of rock, sizes and approximate capacities of multi-stage fine reduction crushers, and cross-sectional and dimensional drawings.

Disbursement Procedure. The Todd Co., Rochester, N. Y.—16-page booklet entitled "Disbursement Methods—Their Use and Misuse" which outlines a system of disbursement procedure providing maximum protection. Contains a clear explanation of 44 tested principles of safe procedure. Well organized and contains pen-and-ink illustrations emphasizing principles discussed in the text.

Electrical Equipment. Barber-Colman Co., Rockford, Ill.—Folder F1695—Condensed data sheet describing this concern's motor-operated valves, control motors, thermostats, and program controllers for sequence operations. Also describes the concern's electric control in industrial applications.

Equipment. Denver Equipment Co., 1400-17th St., Denver, Colo.—Bulletin F8B1—4-page folder which illustrates and describes briefly this concern's rotary filter with drum cast in one piece. Includes diagrammatic drawings and specification charts. Also Bulletin C12B1, 4 pages on the steel frame jaw crusher of anti-friction bearing type put out by this concern. Includes photographs of the unit, brief descriptive material and diagrammatic drawings and specification charts.

Equipment. Link-Belt Corp., 307 N. Michigan Ave., Chicago, Ill.—Book 1929—8-page illustrated catalog of this concern's heavy-duty crawler shovel, dragline, crane. Stresses new features, principles of the machine, working ranges, lifting capacities, and similar information. Illustrated.

Equipment. Lovejoy Flexible Coupling Co., 5001 W. Lake St., Chicago, Ill.—L-R Selector charts—charts designed to aid in selection of proper flexible shaft couplings for light or heavy duty. Includes data on size, bore, load cushions and prices.

Expansion Joints. American District Steam Co., North Tonawanda, N. Y.—Bulletin 3515B—14-page bulletin on this concern's piston-ring type expansion joint which can be unpacked and repacked under full operating pressure without interruption to service. Gives details of construction, dimensions and specifications on the joint which is made in 2 in. to 20 in. for all pressures up to 400 lb. Illustrated.

Generators. Century Electric Co., 1806 Pine St., St. Louis, Mo.—Folder BCA12080—4-page folder dealing with this concern's revolving field generators. Contains photographs of the units and brief descriptive material on operating principles, maintenance and accessories.

Glass. Pittsburgh Plate Glass Co., Grant Building, Pittsburgh, Pa.—30-page booklet entitled "Glass and its Adaptability to Modern Needs" designed primarily to show where glass can be substituted for metal, plastics and other materials now unavailable. Contains extensive and helpful information on the various kinds of glasses put out by this concern, their physical properties, specifications, industrial and general uses. Includes data on polished plate glasses, laminated safety glass, window glass, lighting glasses and other forms.

Gages. Manning, Maxwell & Moore, Inc., Bridgeport, Conn.—1942, 64-page catalog listing the complete line of this concern's gages, gage cases, special service gages, testers, and various accessories. Illustrated.

Heaters. Fedders Mfg. Co., Air Conditioning Div., Buffalo, N. Y.—Catalog AC574—8-page folder describing and illustrating the new line of low-temperature unit heaters put out by this concern. Contains engineering data on capacity, dimensions, typical pipings, and various constants. Also describes outstanding features of the units and their operation.

Heat Insulation. Ehret Magnesia Mfg. Co., Valley Forge, Pa.—176-page heat insulation handbook giving extensive data on heat insulation and related products selected from the Ehret thermal insulation manual. Contains engineering data on principles and practice, heat loss formulas, selection of materials, magnesia insulation, and recommended materials and methods of application. Contains extensive and useful tables and charts. Well illustrated by cross-sectional drawings and photographs of

insulations. Contains 24 pages of engineering tables, graphs and definitions of technical terms. Comprehensive and well organized.

Laboratory Services. The Bauer Bros. Co., Fiber Products Labs., Springfield, Ohio—8-page folder describing briefly and illustrating services and facilities offered by this concern for developing and testing of fibers and their uses.

Lighting. General Electric Co., Lamp Department, Nela Park, Cleveland, Ohio. —12-page booklet entitled "How Light Can Help Win the War". Discusses the relationship of proper lighting in industrial plants to increase production, lowered accident rates, and conservation of time and materials.

Magnetic Separation. Stearns Magnetic Mfg. Co., Milwaukee, Wis.—Bulletin 701—12-page bulletin illustrating and describing this concern's magnetic type "K" gravity induction separators for treating materials of highly reluctant magnetic values. Also contains information on the concern's laboratory facilities available for industrial research work. Illustrated.

Overhead Materials Handling. The Cleveland Crane Engineering Co., Wickliffe, Ohio — Booklet 2008A — 12-page booklet which deals with the complete line of overhead materials handling equipment put out by this concern. Each unit is described briefly and illustrated. Also contains engineering information in chart and drawing form.

Packaging. General Box Co., Chicago, Ill.—12-page booklet dealing with packaging and shipping problems, especially those concerned with boxes, crates, etc. Tells how to conserve man-hours, reduce shipping costs, and eliminate loss and damage claims. Illustrated.

Paints. American-Marietta Co., 43 E. Ohio St., Chicago, Ill.—8-page folder entitled "How to Choose and Use Your Maintenance Paints." Contains paint use and selection charts as well as data on measuring units, light reflection of various standard colors, and an estimated table for quantities of paints for exterior and interior work.

Photoelectric Equipment. Westinghouse Electric & Mfg. Co., Department 7N20, East Pittsburgh, Pa.—Bulletin 18310—6-page bulletin which describes and illustrates briefly industrial applications and general purpose uses of this concern's photoelectric relays, light sources and phototube housings. Gives data on rate of operation, time delay, sensitivity, static and impulse controls, and construction, application and location recommendations on phototube housings. Contains photographs and outline drawings.

Plant Lighting. Goodrich Electric Co., 4600 Belle Plaine Ave., Chicago, Ill.—Folder 101—4-page folder illustrating and describing briefly the principles and applications of plant protection by use of this concern's different types of floodlights. Well illustrated.

Plastics. E. I. du Pont de Nemours & Co., Inc., Wilmington, Del.—Form A2767—22-page booklet telling of some of the outstanding developments and achievements of du Pont plastics during 1941. Includes a discussion on fluorescent lighting, nylon for tennis rackets, fishing equipment, "Lucite" molded articles, industrial signs and plastics for 1942 cars. Illustrated.

Porcelain Filters. The Selas Co., Erie Ave. and D Sts., Philadelphia, Pa.—Bulletin 912—4-page folder which illustrates and discusses briefly applications, outstanding features and other information on this concern's microporous porcelain filters for use in research, control and production. Includes data on sizes, porosities, cleaning technique, and unusual characteristics.

Powder Metallurgy. Charles Hardy Inc., 420 Lexington Ave., New York, N. Y.—3-page reprint entitled "Terms Used in Powder Metallurgy." Contains concise definitions of the more common terms used in this science.

Power Distribution. General Electric Co., Schenectady, N. Y.—Booklet GEA-3758—16-page, two-color booklet which explains the basic principles of load-center power distribution for industrial,

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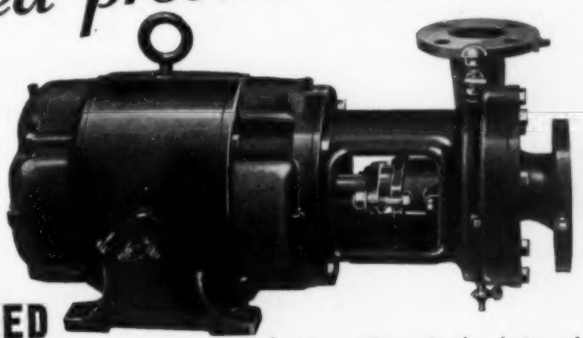

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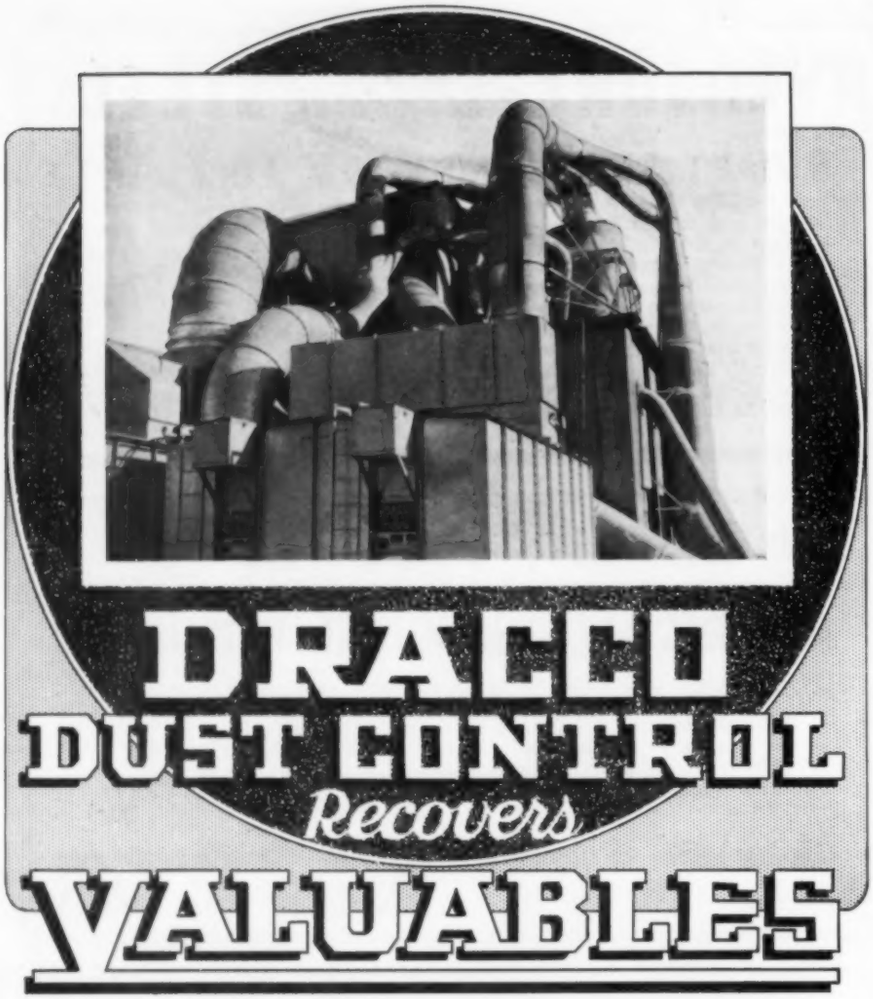

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naval and military projects, central stations, and commercial buildings. Lists the chief advantages of the system, illustrates the available circuit arrangements, describes necessary equipment, and shows typical installations of load-center unit substations.

Pumping. DeLaval Steam Turbine Co., Trenton, N. J.—Two-page reprint entitled "Relation of Suction Head to Capacity with Hot Water Pumps." Illustrated.

Pumps. Blackmer Pump Co., Engineering Department, Grand Rapids, Mich.—Bulletin 302—6-page folder which contains comprehensive tables of friction losses in pipes, viscosity conversion tables, suction lifts, resistance of valves and fittings to flow of liquids, tables and other data frequently required by those who install pumps and make piping layouts. Data are arranged in tables in easily accessible form.

Pumps. Chain Belt Co., Milwaukee, Wis.—Bulletin 400—22-page catalog illustrating and describing this concern's line of centrifugal water pumps in capacities ranging from 3,000-125,000 gal. per hour. Contains data on specifications, capacities, pressure conversion tables and other engineering features.

Pumps. Denver Equipment Co. 1400–17th St., Denver, Colo.—Bulletin P6B—4-page folder which discusses briefly and illustrates this concern's line of diaphragm pumps and vertical sand pumps. Diagrammatic drawings show principles of operation and photographs show units in actual operations.

Pumps. Worthington Pump & Machinery Corp., Harrison, N. J.—Bulletin W411B31—8-page folder which illustrates and describes the essential features of the horizontal duplex power pumps of 10-in. stroke put out by this concern. Includes cross-sectional drawings, selection data, photographs of actual installations and dimension tables.

Rotary Switches. Roller-Smith Co., Bethlehem, Pa.—Catalog 7140—16-page catalog dealing with this concern's complete line of rotary switches of various types. Includes comprehensive information on applications, operating principles, specifications and costs, and several pages on diagrams of connections and switch developments. Well illustrated by photographs and drawings of the units.

Rubber. The British Rubber Publicity Association, 19 Fenchurch St., London, E.C.3,—Card indicator showing the properties and applications of rubber according to type. Intended for ready reference.

Rubber. Naugatuck Chemical Co., Dispersions Process, Inc., 1230 Sixth Ave., New York, N. Y.—100-page, loose-leaf file-folder dealing with all aspects of the various types of water dispersed rubbers put out by this concern. Various sections deal with the story of dispersed rubber, "Lotol," this concern's compounded latex ready to use, "Dispersite," latex, general handling data, machinery and equipment available for the handling of water dispersions of rubber, and miscellaneous engineering information. Includes data on uses of water dispersed rubber, properties, and similar information. Extensively illustrated.

Screens. Robins Conveying Belt Co., Passaic, N. J.—Bulletin 115—22-page attractively bound catalog dealing with this concern's "Gyrex" vibrating screens. A novel method illustrates the various parts of the screen while alongside the text discusses outstanding features of the various parts. Includes installation photographs of the screens, data on various applications, detailed dimension tables of the single, double, and triple deck types, and cross-sectional drawings.

Turbines. DeLaval Steam Turbine Co., Trenton, N. J.—2-page reprint entitled "Steam-Flow Characteristics of Extraction Turbines" which shows relations between throttle flow and output for conditions of minimum flow to exhaust, maximum flow to exhaust, and various percentages of extraction.

Turbines. Moore Steam Turbine Div., Worthington Pump & Machinery Corp.,

Wellsville, N. Y.—6-page folder on the concern's steam turbines with combined reduction gears. Contains cross-sectional and dimension drawings, photographs of the various units and their parts, and brief descriptional material.

Ultra-Violet Light. Ultra-Violet Products, Inc., 5205 Santa Monica Blvd., Los Angeles, Calif.—Folder containing instructions and data on the use of ultra-violet light for identifying tungsten ores. Illustrates and describes 15 models of this concern's black light lamps available for this purpose. Also deals with other industrial uses for ultra-violet light.

Valves. The Edward Valve & Mfg. Co., Inc., E. Chicago, Ind.—**Catalog 12G5**—4-page folder describing the new hard-surfaced integral seat globe stop valves for pressures up to 1500 lb. at 950 deg. F. put out by this concern. Contains brief descriptive material, photographs of principal features, and tables of dimensions and sizes.

Valves. Jenkins Bros., 80 White St., New York, N. Y.—14-page catalog listing this concern's stainless steel valves of gate, globe and angle, lift check, swing check, and other types. Each unit is illustrated by a cross-sectional drawing, and specifications, dimensions, accessories and principle features are described.

Valves. R-S Products Corp., 4530 Germantown Ave., Philadelphia, Pa.—Catalog 10B—16-page catalog dealing with this concern's precision machined and wedge-tight butterfly valves for control of air, gas, steam, liquids and semi-solids under high and sub-zero temperatures and various pressures. Contains performance characteristics, description of construction, specifications and flow charts. Well illustrated with photographs, sketches and charts.

Vibrating Screens. Robins Conveying Belt Co., Passaic, N. J.—Bulletin 118—4-page folder which illustrates and describes very briefly this concern's new high-speed pulley type vibrating screen with super-sealed, oil-lubricated bearings.

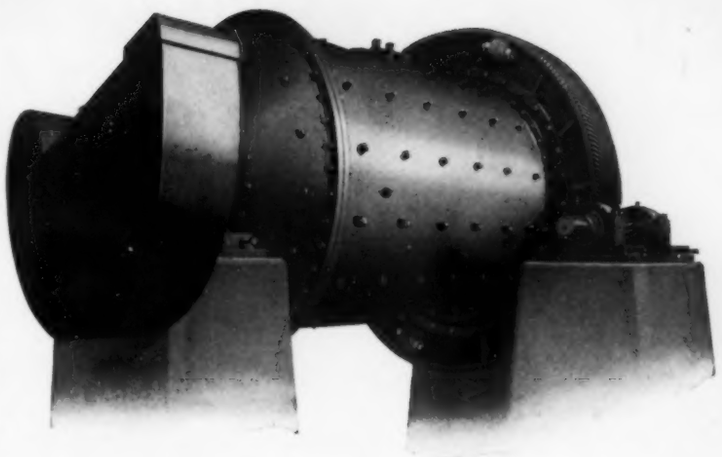
Waterproofing. Primoid Products Corp., 103 Park Ave., New York, N. Y.—4-page folder which describes briefly and gives applications of this concern's various rubber-base compounds for stopping leaks or seepage through bricks, concrete, stucco and other types of masonry and for preventing corrosion or rusting of metals.

Water Treatment. Proportioneers, Inc., 9 Codding St., Providence, R. I.—one-page sheet which gives treatment data for heavy-duty midget Calgon feeder, including solution strength, pump capacity, belt setting and stroke length setting. Also one-page drawing showing parts and dimensions of this concern's fluid drive "Chem-O-Feeder" as well as installation drawings for flow proportional treatment of water pumped by reciprocating pumps. Also 4-page folder which illustrates and describes briefly the concern's deluxe "Chem-O-Feeder".

Water Treatment. Technicraft Engineering Co., 5610 S. Soto St., Los Angeles, Calif.—8-page folder describing this concern's "SterOzone" method of water purification without the use of chemicals. Describes and illustrates the unit for purifying water by generating ozone. Discusses outstanding features, efficiency and cost, power requirement, and specifications. Includes diagrammatic sketches and charts.

Water Treatment. Wallace & Tiernan Co., Inc., Newark, N. J.—14-page bulletin which deals briefly with 15 actual cases where production problems were solved by microbiological quality control of processed water. Includes a brief description of this concern's chlorine and ammonium control apparatus for water treatment.

Welding. The Lincoln Electric Co., Cleveland, Ohio—Bulletin 412—20-page bulletin on this concern's "Shield-Arc" welder with self-indicating dual continuous control. Contains brief descriptive material and photographic illustrations of actual installations and technique. Contains considerable information on the technical features of this dual control system.



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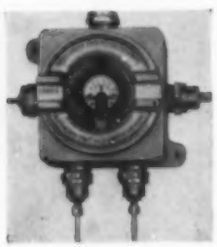
M. S. A. *Explosionproof* COMBUSTIBLE GAS ALARM



Provides instant warning when gaseous concentrations reach a pre-determined limit, and may be adapted for automatic process or ventilation control. The Alarm, including sampling pump, is completely contained in an explosionproof condulet and is safe for use in gaseous atmospheres. Each instrument is specifically calibrated for the particular gas or vapor which it will test; measuring circuit is adjustable to operate signal at any predetermined point. Bulletin No. DT-2.

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Portable, hand-operated, U. S. Bureau of Mines-approved. May be carried and used wherever CO is a potential hazard, indicating presence of the gas in concentrations in excess of .05%. Positive, simple and practical, the Detector operates by squeezing a bulb which forces air through tube of chemical which changes color in direct proportion to amount of CO in air. Comparison with standard color tube determines CO concentration. Instrument and 12 detector tubes are contained in sturdy carrying case. Bulletin No. BF-1.

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M. S. A. HAND-OPERATED CARBON MONOXIDE INDICATOR

Provides precise indication of carbon monoxide hazards on-the-job, without connections to storage batteries or any outside power source. Self-contained, easily portable, simple in operation, and safe to use even where flammable gases may be present. A small, highly efficient four-cylinder hand-operated radial pump develops proper sampling suction with little effort. Automatically regulated sample flow is indicated on pressure gauge. Direct-reading meter has scale range from 0 to .15% in air; can be read directly to .005% and estimated to .001% (10 parts per million). Motor-operated models also available. Bulletin No. DS-3.

M. S. A. MULTIPLE SAMPLING COMBUSTIBLE GAS ALARM

A complete panel installation for continuously measuring combustible gas hazards at a number of sampling points, employing the M.S.A. Combustible Gas Alarm with multi-way sampling valve. Valve enables analysis of four, six or eight localities by the single alarm; rotating indexing drum automatically shows by visible number the line under test at any time. A recording potentiometer can be provided for continuous graphic record of combustibles present in sampled atmospheres. Installation is furnished completely assembled and ready for use. Details on application.

M. S. A. HYDROGEN SULPHIDE DETECTOR

The only available instrument of its kind, the M.S.A. H_2S Detector is invaluable for rapid and accurate detection and measurement of low but dangerous concentrations of this highly toxic gas, on-the-job. Hand operated, light, compact and easily carried, the unit indicates H_2S concentrations from .0025% to .04% by volume. Anyone can use it, in the many fields where hydrogen sulphide occurs. Bulletin No. DY-2.

M. S. A. OXYGEN RECORDER

The new panel mounted M.S.A. Oxygen Recorder continuously analyzes and records concentrations of oxygen in gaseous mixtures. Can be supplied to analyze from 0 to 15% oxygen or any range within these limits. Used in chemical processes; measurement of excess air in products of combustion; measurement of oxygen in natural and manufactured gases, etc. Full details of this latest development of M.S.A. Research are contained in Bulletin No. DW-2.

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CONTROLS OVER INDUSTRIES AND MATERIALS BRING CHANGES IN DISTRIBUTION OF CHEMICALS

CHEM & MET ECONOMICS & MARKETS

BOTH production and consumption of chemicals are on a steadily rising trend. Most of the heavy tonnage items are in the essential classification and some of them entered the year with added capacities in operation so they are in a position to surpass the record outputs reported for last year. They include such chemicals as sulphuric, nitric, and hydrochloric acids, ammonia, chlorine, caustic soda, soda ash, superphosphate, alcohol, phenol, and toluol. Consuming demand is on a par with, or in excess of, the volume of production. Hence, from an over-all viewpoint, the first quarter of this year will record an all-time high for the industry both for output and for use. Within the industry, however, the effects of controls over entire consuming branches and over distributions of materials is becoming more apparent.

This may be illustrated in the case of chlorine. Last year the pulp and paper industry was ordered to cut down its use of this chemical with the reduction definitely specified. Last month, other industries where chlorine is used as a bleaching agent were ordered to discontinue this practise. Other lines were asked to reduce their requirements. The current rate of chlorine output is the highest on record and it is being moved promptly from producing points yet many of the ordinary distribution channels are either closed or are greatly restricted. A larger part of chlorine production than ever before is going into the manufacture of chlorinated solvents, yet on March 2, fabricators of metals were requested to investigate every possible cleaning method other than chlorinated solvents applicable to their operations.

Allocation of metal supplies already has been reflected in smaller outputs of metal salts. Distribution of chrome ore which previously had been under control was further restricted last month when definite limits were placed on the amounts which may be converted into chrome chemicals. While marked advances have been made in production of war goods since the first of the year, the immensity of the program as it has been outlined, gives some idea of the amount of materials that will be required when operations reach their peak. This, in turn, points to much more drastic reductions in supplies for civilian purposes in the future as it is probable that future expansion in production of raw materials will be offset by the enlarged demand in essential lines.

In addition to dislocations which are resulting from the scarcity of materials, operations in non-essential manufactures may be held in check by the lack of available power. At the close of last month, the War Production Board issued a limitation order which can be used to curtail use of electric power in Buffalo, Niagara Falls, and western New York when and if power shortages develop. Among other things, the order specifically provides for mandatory reduction up to 50 percent in the power demands of large consumers who are not engaged in war production or essential civilian services. This reduction to be made during periods of power shortage only when the availability of supply is insufficient to meet the demand after steps have been taken to develop maximum power resources.

The shipping situation also has brought up a problem of storage facilities. The annual convention of the American Warehousemen's Association was informed that production of material for export—particularly lend-lease material—soon will exceed ship space immediately available and storage space will be required in production areas. Producing plants can not supply the needed space and the ports must not be blocked. Furthermore, Army Quartermasters and various Corps Areas may need space beyond their depot capacity.

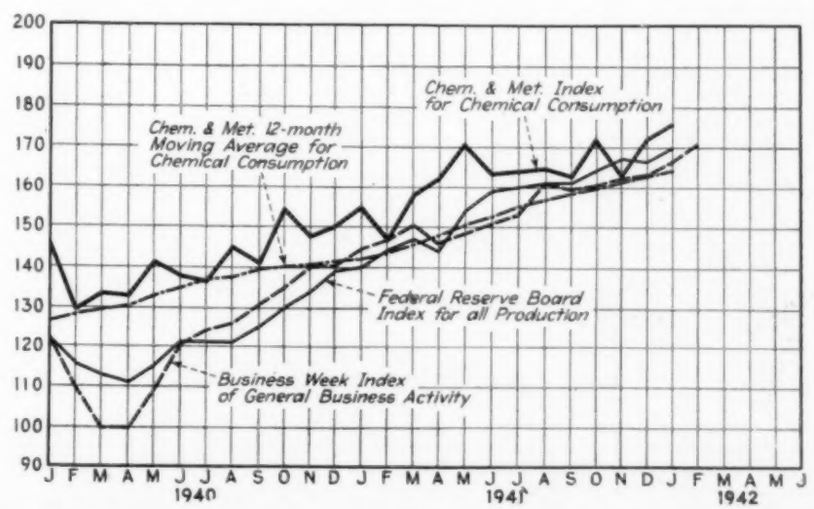
Statistics regarding current activities in some of the principal chemical-consuming lines are being withheld. For instance, data for consumption of crude rubber and for reclaimed operations are no longer made public and only a very sketchy estimate can be given for the amount of chemicals which are now being used in that direction. The restrictions placed on use of rubber combined with the drop in tire output undoubtedly has caused a material drop in rubber fabrication but war uses are steadily mounting and there is real necessity for augmenting supplies.

Steel mills began the month with record activity. Reports of steel-mill operations as given in terms of percent of capacity are not comparable with those of a year ago because as capacities are expanded, the basis is moved up. Thus, operating rates reported for this year to date are based on annual capacities of 78,107,260 net tons of open-hearth steel, 6,721,400 tons of bessemer steel, and 3,737,510 tons of electric steel. The new capacity—as of Dec. 31, 1941—is 2,421,000 tons above that of June 30 and 4,418,000 tons above that of Dec. 31, 1940.

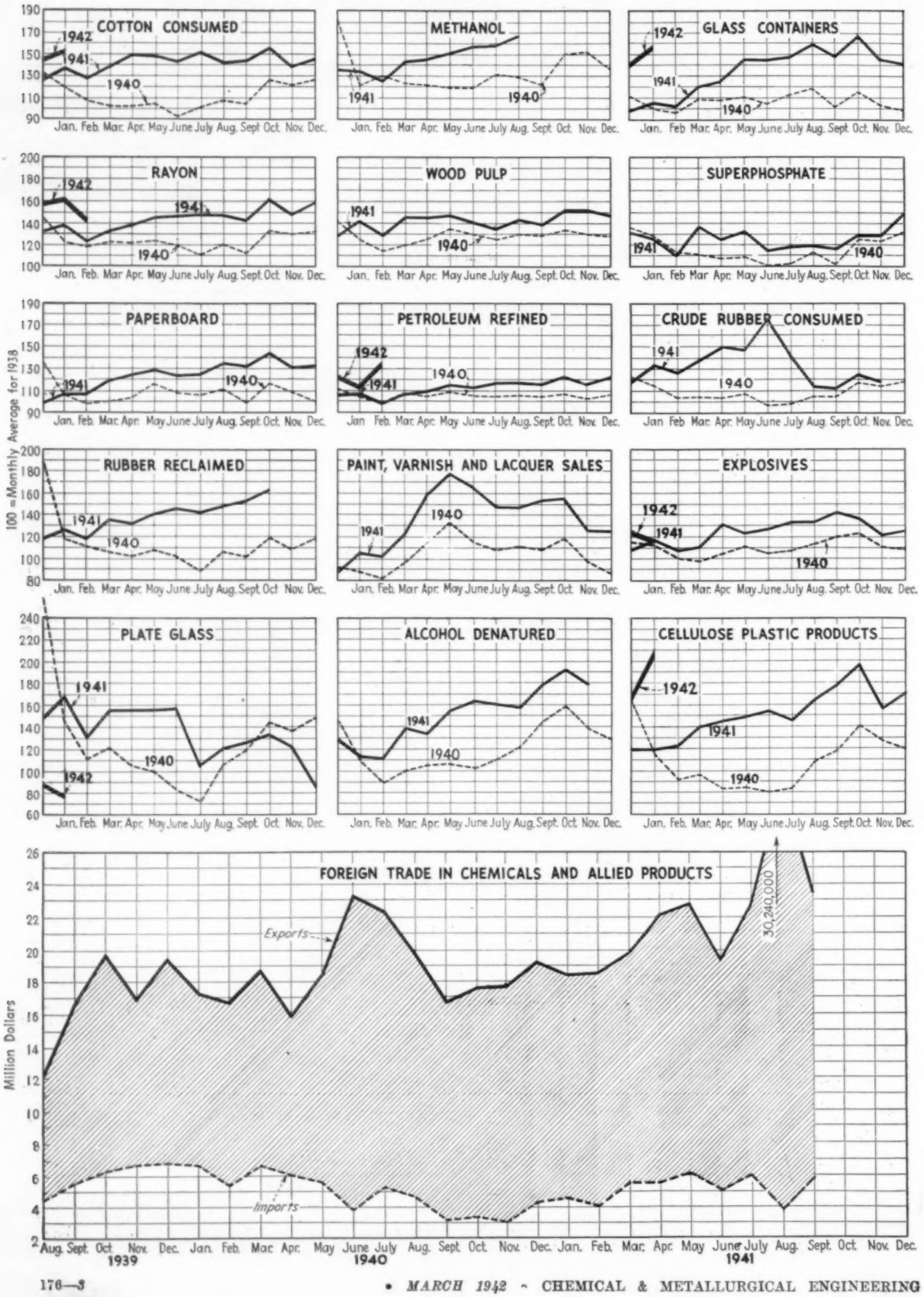
The fertilizer industry is giving full cooperation to the proposal to increase agricultural yields this year. Production of superphosphate was larger than anticipated in December with output reported at 487,558 tons of bulk and 7,299 tons of wet base and wet mixed goods. In the field of plastics, particular prominence is given to the sharp rise in outputs of cellulose acetate molding composition. In January, production amounted to 3,788,786 lb. which was more than 10 percent higher than the previous peak reached last October. Spotted conditions exist at glass plants with production of plate glass being reduced because of the drop in demand from the automotive trade. Window glass plants are active and the same is true for the container branch.

Chem. & Met. Index for Industrial Consumption of Chemicals

	Dec. 1941	Jan. 1942
Fertilizer	37.73	38.00
Pulp and paper	22.35	22.70
Petroleum refining	16.26	15.57
Glass	14.80	15.39
Paint and varnish	13.54	15.28
Iron and steel	13.00	13.45
Rayon	14.30	15.10
Textiles	12.01	12.07
Coal products	9.79	9.84
Leather	5.10	5.30
Industrial explosives	5.67	5.78
Rubber	3.85	3.00
Plastics	4.10	4.40
	172.50	175.88



Production and Consumption Trends



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CARBON BLACK

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Most chemists or physicists know carbon blacks are the best reinforcing agents for rubber, are dispersible in many mediums, are the most finely divided of all pigments, that they are nontoxic and nonirritating.

Few realize there are 33 distinctly different channel blacks with surface areas ranging from 100 to 900 square meters per gram, volatile contents from 4 to 18%, pHs from 2 to 6, apparent densities of from 5 to 22 pounds per cubic foot, and that this wide variety permits selection for many desired characteristics in such fields as electrical conductivity, selective absorption in liquids or gases, reinforcement of compounds, absorption of radiant heat, or just plain blackness.

In this large group may be an ideal and inexpensive answer to your problem. There is no shortage of these carbons which sell for from 3.55 cents to $1.00 per pound.

An inquiry will bring you the assistance of our laboratories.

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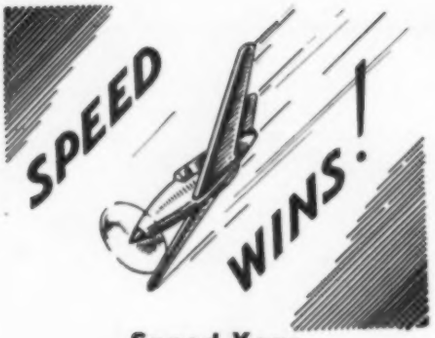
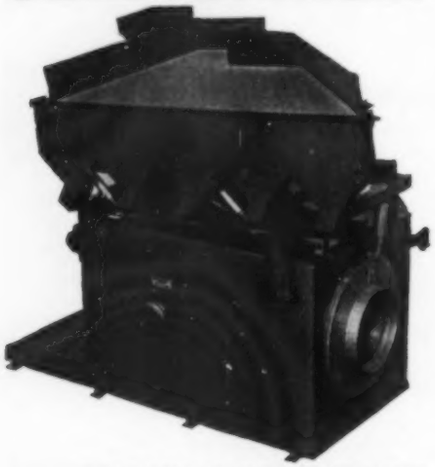


Speed Your
SEPARATION
PROCESSING
WITH THE

AIR-FLOAT
SEPARATOR



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The Air-Float Separator Offers

★ 1. Higher grade product, less loss than wet separation.
★ 2. No water supply needed. Can be located anywhere. Saves pump money.
★ 3. Increases capacity, reduces units, space, power costs.
★ 4. Greater sensitivity to slight difference in densities, successfully treats materials which "wet" methods cannot concentrate.
★ 5. Larger sizes may be treated. Fine grinding eliminated. Slime tonnage cut down.
★ 6. Dry finished product handled, shipped, marketed at low cost.
★ 7. Handles not only ores but slags, drosses, chemicals, beans, seeds and any dry material composed of mixtures of different weights.

● Allow us to submit recommendations, based on your requirements. Arrange to send us a suitable sample for laboratory test runs.

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THE S&S PROCESS FOR BETTER PRODUCTS—FASTER

SUPERVISION OVER CHEMICAL DISTRIBUTION AND PRICES IS INCREASINGLY EXTENDED

FACTORS which ordinarily control market activity and price fluctuations have been so completely superseded by the establishment of controls that important developments now are almost entirely connected with the new regulations which are promulgated from month to month. Chlorine which already had been restricted for specified uses came under further restrictions at the turn of the month. Use of chlorine in textile bleaching is cut to about 50 percent of the amount used in the year ended June 30, 1941. Shellac bleaching is cut by approximately 25 percent under the same regulation. All laundry operations must do without chlorine with the exception of 10 percent of former usage for stain conditions. Manufacturers of sodium hypochlorite solutions in small containers for retail must reduce use of chlorine by 40 percent and owners of private swimming pools are allocated 25 percent of the amount used in the base period. The order further prohibits use of chlorine or products containing available chlorine in bleaching foodstuffs, wiping rags and waste, and manufacture of cosmetics and toilet preparations. A complete list of preference ratings, other than those for war requirements is included in the order.

Conservation of tungsten was the purpose of order M-29-b which prohibits use of the metal after May 1, as coloring material for rubber, linoleum, paper, or other similar materials. Until May 1, users ore limited to 17½ percent of the amount used in the year ended June 30, 1941. Chromium has been placed under complete allocation and this includes chromium used in all chemical combinations having the metal as an essential and recognizable component. Referring specifically to chemicals the order limits use of chrome ore in any month to one-twelfth the aggregate weight of such oxide content used in making the total of chrome chemicals delivered by the processor during the fiscal year of 1941. Madagascar flake graphite may be used only for manufacture of crucibles for the war effort and after Feb. 23 such crucible manufacture is permissible only on specific authorization. Cobalt in all forms likewise is under the allocation system and after May 1, its use in all pigments is prohibited and until then only 40 percent of the amount used in the first half of last year is permitted. Blue optical glass and blue glass for other safety uses are not included.

All stocks of chlorinated rubber, except those going into specified uses were frozen on Feb. 23, preparatory to requisitioning by the War Production Board or diversion into war production. Permissible uses are as a paint for interior use in industrial plants where resistance to chemical corrosion is necessary; as a paint in arsenals; for painting ship bottoms and other submarine uses. Also for flame-proofing military fabrics, including tents; tracer bullets; for adhering rubber articles to metal; and for electrical insulation. While facilities for production are being greatly increased, military demands are in excess of supply. The material has been under a monthly allocation system since Nov. 1 and none is now going for non-military use. Principal civilian uses which are prohibited include: swimming pools and other concrete and masonry paint; treatment of fabrics, papers and printing inks for greaseproofing and to increase resistance to chemical action; bottle cap closures; and fast drying paint finishes.

Under date of Feb. 13 a general notice was issued to the effect that all price schedules issued by O.P.A. since its creation will remain in effect under terms of the Emergency Price Control Act of 1942. To the price ceilings and controls issued previously, several additions were made in February. On Feb. 28, permission to fulfill certain contracts at higher than established prices for lithopone was granted to dealers and exporters, other than manufacturers. This amendment affected only lithopone in the hands of exporters or dealers or in the hands of a carrier or warehouse prior to Feb. 2 to meet contracts made prior to that date. Under specified conditions deliveries to buyers may be made under the terms of the contracts. A somewhat similar order made it possible for dealers in mercury to meet sales contracts up to March 2. Maximum prices for mercury went into effect on Feb. 4 with the Pacific Coast figure set at $191 a flask fob point of shipment; Texas and Mexico at the same price; and imports from Mexico at $193 a flask fob freight station at or nearest the boundary at which shipment enters the United States. Dealers in mercury may sell at the established base price plus 2 percent and plus actual transportation charges.

Earlier in the month, prices had been fixed for salicylic acid in different

CHEM. & MET.
Weighted Index of
CHEMICAL PRICES

Base=100 for 1937

This month	**109.19**
Last month	109.20
March, 1941	99.98
March, 1940	98.84

The price situation has changed but little in the past month. The majority of chemicals maintain a schedule fixed either by government order or by voluntary action on the part of producers. In the solvents field, spirits of turpentine continue to fluctuate according to current influences and the trend recently has been toward lower levels.

grades, containers, and quantities. The schedule also fixed prices for resale lots. For producers and primary jobbers the carlot figure was set at 28c. a lb. with 36c. a lb. the resale figure. The range went up to 46c. a lb. for producers in 1-lb. cartons and to 60c. a lb. for resellers. Acetyl salicylic acid went under price control at the same time with the schedule varying according to grade and quantity. For 50 mesh or 20-40 mesh crystals the maximum price is 52c. a lb. for 200 lb. or more in barrels. Vitamin C or ascorbic acid likewise was included with the ceiling placed at $1.65 an oz. in lots of 1,000 oz. or more. For resellers the maximum for such quantities is $2.15 an oz. The resale and export market for citric acid had been erratic with abnormally high prices entering into transactions. Hence this material came under scrutiny and ceilings were adopted on a basis of 20c. a lb. for carlots fob producers or primary jobbers shipping point. For resellers the maximum is 26c. a lb. For smaller lots, prices are scaled upward.

Other developments bearing on prices included a request to exporters of paraffin wax not to buy from producers or jobbers at prices in excess of those allowed under the price schedule for domestic sales. Producers of nicotine sulphate were asked to observe maximum prices of 80c. a lb. for the 40 percent product delivered in 50-lb. drums. Conferences were held to discuss ceilings for coal-tar products including naphthalene, cresols, cresylic acid and xylenols, and creosote and pitch.

A practice developed some years ago in Russia and Germany will be utilized —and perhaps improved upon—to help increase America's production of naval stores this year to the Department of Agriculture's goals of 158 percent of 1941 production. The procedure involves painting the cut on slash pine with a dilute solution of sulphuric acid, which tests show often increases the yield up to 50 percent. Sulphuric acid, however, apparently does not work on long leaf pine and the southern forestry experiment station in New Orleans has been assigned to seek another acid which will produce this result.

CHEM. & MET.

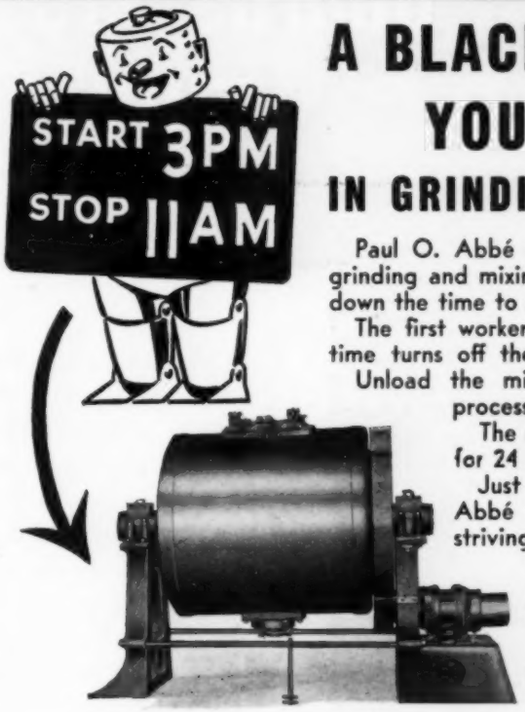
Weighted Index of Prices for

OILS & FATS

Base=100 for 1937

This month	**141.32**
Last month	139.36
March, 1941	80.58
March, 1940	81.53

Many of the oils are in a more or less nominal price position. Holders of stocks are not offering freely and forward positions for foreign oils are subject to so many uncertainties that no definite prices can be quoted. Ceilings are effective for most oils but higher prices for castor beans have forced an upward adjustment in sales schedules for the oil.



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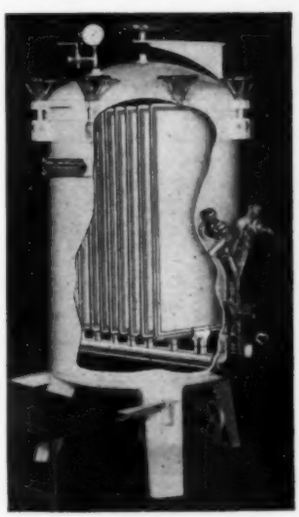
MASTER-AID Filters



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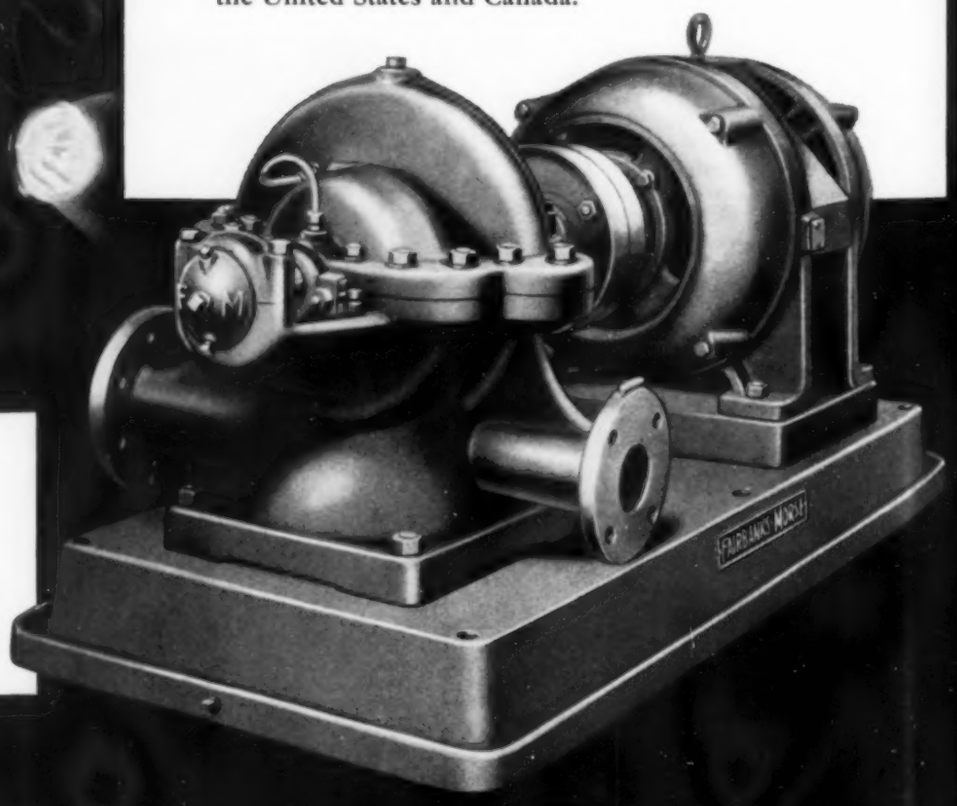
These unsuspected saboteurs *are* at work in your plant if your pumps are not of the latest, improved designs. For ten-year-old pumps of certain types, even if as good as new, require 25% more power than today's Fairbanks-Morse models. And 4- or 5-year-old pumps of other types consume so much more power than current models that continued use is more costly than replacement.

Find out *now* if *your* pumps are the types which curtail production and steal power and profits. Let a Fairbanks-Morse Pump Engineer make an inspection, with no cost or obligation to you. Write Fairbanks, Morse & Co., Dept. C19, 600 S. Michigan Ave., Chicago. Branches and service stations throughout the United States and Canada.



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A complete "family" of single-stage, split-case pumps for low, moderate, medium, and high heads, is described in Bulletin 5810D. Many other bulletins available on other types.

FAIRBANKS·MORSE PUMPS

DIESEL ENGINES ELECTRICAL MACHINERY MAGNETOS RAILROAD EQUIPMENT WASHERS-IRONERS STOKERS

CHEM & MET CURRENT PRICES

INDUSTRIAL CHEMICALS

	Current Price	Last Month	Last Year
Acetone, drums, lb.	$0.168–$0.173	$0.168– $.173	$0.07½–$0.08
Acid, acetic, 28%, bbl., cwt.	3.38 – 3.63	3.38 – 3.63	2.23 – 2.48
Glacial 99.5%, drums	9.15 – 9.40	9.15 – 9.40	8.43 – 8.68
U. S. P. X 1, 99.5%, dr.	10.95 –11.20	10.95 –11.20	10.25 –10.50
Boric, bbl., ton	108.00–113.00	108.00–113.00	106.00–111.00
Citric, kegs, lb.	.20 – .23	.20 – .23	.20 – .23
Formic, cbys., lb.	.10½– .11	.10½– .11	.10½– .11
Gallic, tech., bbl., lb.	1.10 – 1.15	1.10 – 1.15	.90 – 1.00
Hydrofluoric 30% drums, lb.	.08 – .08½	.08 – .08½	.08 – .08½
Lactic, 44%, tech., light, bbl., lb.	.073– .075	.073– .075	.06½– .06¾
Muriatic, 18°, tanks, cwt.	1.05 –	1.05 –	1.05 –
Nitric, 36°, carboys, lb.	.05 – .05½	.05 – .05½	.05 – .05½
Oleum, tanks, wks., ton	18.50 –20.00	18.50 –	18.50 –20.00
Oxalic, crystals, bbl., lb.	.11½– .13	.11½– .13	.10½– .12
Phosphoric, tech., c'bys., lb.	.07½– .08½	.07½– .08½	.07½– .08½
Sulphuric, 60°, tanks, ton	13.00 –	13.00 –	13.00 –
Sulphuric, 66°, tanks, ton	16.50 –	16.50 –	16.50 –
Tannic, tech., bbl., lb.	.71 – .73	.71 – .73	.54 – .56
Tartaric, powd., bbl., lb.	.70 –	.70 –	.57½–
Tungstic, bbl., lb.	nom	nom	nom
Alcohol, amyl			
From Pentane, tanks, lb.	.131–	.131–	.111–
Alcohol, Butyl, tanks, lb.	.158–	.158–	.09 –
Alcohol, Ethyl, 190 p'f., bbl., gal.	8.19 – 8.25	8.19 – 8.25	6.04 –
Denatured, 190 proof			
No. 1 special, dr., gal. wks.	.60 –	.60 –	.31½–
Alum, ammonia, lump, bbl., lb.	.03½– .04	.03½– .04	.03½– .04
Potash, lump, bbl., lb.	.04 – .04¼	.04 – .04¼	.03½– .04
Aluminum sulphate, com. bags, cwt.	1.15 – 1.40	1.15 – 1.40	1.15 – 1.40
Iron free, bg., cwt.	1.85 – 2.10	1.85 – 2.10	1.60 – 1.70
Aqua ammonia, 26°, drums, lb.	.02½– .03	.02½– .03	.02½– .03
tanks, lb.	.02 – .02½	.02 – .02½	.02 – .02½
Ammonia, anhydrous, cyl., lb.	.16 –	.16 –	.16 –
tanks, lb.	.04½–	.04½–	.04½–
Ammonium carbonate, powd. tech., casks, lb.	.09½– .12	.09 – .12	.09 – .12
Sulphate, wks., cwt.	1.45 –	1.45 –	1.45 –
Amylacetate tech., from pentane, tanks, lb.	.145–	.145–	.105–
Antimony Oxide, bbl., lb.	.15 –	.15 –	.12–
Arsenic, white, powd., bbl., lb.	.04 – .04¼	.04 – .04¼	.03½– .04
Red, powd., kegs, lb.	nom	nom	.17 – .18
Barium carbonate, bbl., ton	60.00 –65.00	60.00 –65.00	52.50 –57.50
Chloride, bbl., ton	79.00 –81.00	79.00 –81.00	79.00 –81.00
Nitrate, casks, lb.	.10½– .11	.10½– .11	.08½– .10
Blanc fix, dry, bbl., lb.	.03½– .04	.03½– .04	.03½– .04
Bleaching powder, f.o.b., wks., drums, cwt.	2.25 – 2.35	2.25 – 2.35	2.00 – 2.10
Borax, gran., bags, ton.	44.00 –	44.00 –	43.00 –
Bromine, cs., lb.	.30 – .32	.30 – .32	.30 – .32
Calcium acetate, bags	3.00 –	3.00 –	1.90 –
Arsenate, dr., lb.	.07 – .08	.06½– .07	.06½– .06¾
Carbide drums, lb.	.04½– .05	.04½– .05	.04½– .05
Chloride, fused, dr., del., ton.	19.00 –24.50	19.00 –24.50	19.00 –24.50
flake, dr., del., ton.	20.50 –25.00	20.50 –25.00	20.50 –25.00
Phosphate, bbl., lb.	.07½– .08	.07½– .08	.07½– .08
Carbon bisulphide, drums, lb.	.05½–	.05½–	.05 –
Tetrachloride drums, gal.	.73 – .80	.73 – .80	.66½– .73
Chlorine, liquid, tanks, wks., lb.	2.00 –	2.00 –	1.75 –
Cylinders	.05½– .06	.05½– .06	.05½– .06
Cobalt oxide, cans, lb.	1.84 – 1.87	1.84 – 1.87	1.84 – 1.87
Copperas, bgs., f.o.b., wks., ton.	18.00 –19.00	18.00 –19.00	18.00 –19.00
Copper carbonate, bbl., lb.	.18 – .20	.18 – .20	.10 – .16
Sulphate, bbl., cwt.	5.15 – 5.40	5.15 – 5.40	4.75 – 5.00
Cream of tartar, bbl., lb.	.57 –	.57 –	.47½–
Diethylene glycol, dr., lb.	.14 – .15½	.14 – .15½	.22 – .23
Epsom salt, dom., tech., bbl., cwt.	1.90 – 2.00	1.90 – 2.00	1.80 – 2.00
Ethyl acetate, drums, lb.	.12–	.12 –	.07½–
Formaldehyde, 40%, bbl., lb.	.05½– .06	.05½– .06½	.05½– .06
Furfural, tanks, lb.	.09 –	.09 –	.09 –
Fusel oil, drums, lb.	.18 – .19	.17½– .19	.16 – .17
Glaubers salt, bags, cwt.	1.05 – 1.10	1.05 – 1.10	.95 – 1.00
Glycerine, c.p., drums, extra, lb.	.18½–	.18½–	.12½–
Lead;			
White, basic carbonate, dry casks, lb.	.08½–	.08½–	.07½–
White, basic sulphate, sck., lb.	.07½–	.07½–	.07 –
Red, dry, sck., lb.	.09½– .09¾	.09½–	.08½–
Lead acetate, white crys., bbl., lb.	.12 – .13	.12 – .13	.11 – .12
Lead arsenate, powd., bag, lb.	.11 – .12	.11 – .12	.09½– .11
Lime, chem., bulk, ton	8.50 –	8.50 –	8.50 –
Litharge, pwd., csk., lb.	.08½–	.08½–	.07½–
Lithopone, bags, lb.	.04½– .04¾	.04½– .04¾	.03½– .04
Magnesium carb., tech., bags, lb.	.06½– .06¾	.06½– .06¾	.06½– .06¾
Menthanol, 95%, tanks, gal.	.60 –	.60 –	.29 –
97%, tanks, gal.	.60 –	.60 –	.30 –
Synthetic, tanks, gal.	.28 –	.28 –	.30 –
Nickel salt, double, bbl., lb.	.13½– .13¾	.13½– .13¾	.13½– .12¾
Orange mineral, csk., lb.	.12½–	.12½–	.11½–
Phosphorus, red, cases, lb.	.40 – .42	.40 – .42	.40 – .42
Yellow, cases, lb.	.18 – .25	.18 – .25	.18 – .25
Potassium bichromate, casks, lb.	.09½– .10	.09½– .10	.08½– .09
Carbonate, 80–85%, calc. csk., lb.	.06½– .07	.06½– .07	.06½– .07
Chlorate, powd., lb.	.10 – .12	.10 – .12	.10 – .12
Hydroxide (c'stic potash) dr., lb.	.07 – .07½	.07 – .07½	.07 – .07½
Muriate, 60% bags, unit	.53½–	.53½–	.53½–
Nitrate, bbl., lb.	.05½– .06	.05½– .06	.05½– .06
Permanganate, drums, lb.	.19½– .20	.19½– .20	.18½– .19
Prussiate, yellow, casks, lb.	.17 – .18	.17 – .18	.15 – .16
Sal ammoniac, white, casks, lb.	.0515– .06	.0515– .06	.0515– .06
Salsoda, bbl., cwt.	1.00 – 1.05	1.00 – 1.05	1.00 – 1.05
Salt cake, bulk, ton.	17.00 –	17.00 –	17.00 –
Soda ash, light, 58%, bags, contract, cwt.	1.05 –	1.05 –	1.05 –
Dense, bags, cwt.	1.10 –	1.10 –	1.10 –
Soda, caustic, 76%, solid, drums, cwt.	2.30 – 3.00	2.30 – 3.00	2.30 – 3.00
Acetate, del., bbl., lb.	.04½– .06	.04½– .06	.04 – 05
Bicarbonate, bbl., cwt.	1.70 – 2.00	1.70 – 2.00	1.70 – 2.00
Bichromate, casks, lb.	.07½– .08	.07½– .08	.06½– .07
Bisulphate, bulk, ton	16.00 –17.00	16.00 –17.00	15.00 –16.00
Bisulphite, bbl., lb.	.03 – .04	.03 – .04	.03 – .04
Chlorate, kegs, lb.	.06½– .06¾	.06½– .06¾	.06½– .06¾
Cyanide, cases, dom., lb.	.14 – .15	.14 – .15	.14 – .15
Fluoride, bbl., lb.	.08 – .09	.08 – .09	.07 – .08
Hyposulphite, bbl., cwt.	2.40 – 2.50	2.40 – 2.50	2.40 – 2.50
Metasilicate, bbl., cwt.	2.50 – 2.65	2.50 – 2.65	2.35 – 2.40
Nitrate, bulk, cwt.	1.35 –	1.35 –	1.45 –
Nitrite, casks, lb.	.06½– .07	.06½– .07	.06½– .07
Phosphate, tribasic, bags, lb.	2.70 –	2.70 –	2.35 –
Prussiate, yel. drums, lb.	.10½– .11	.10½– .11	.10½– .11
Silicate (40° dr.), wks., cwt.	.80 – .85	.80 – .85	.80 – .85
Sulphide, fused, 60–62%, dr. lb.	.03 – .03½	.03 – .03½	.02½– .03
Sulphite, crys., bbl., lb.	.02½– .02¾	.02½– .02¾	.02½– .02¾
Sulphur, crude at mine, bulk, ton.	16.00 –	16.00 –	16.00 –
Chloride, dr., lb.	.03 – .04	.03 – .04	.03 – .04
Dioxide, cyl., lb.	.07 – .08	.07 – .08	.07 – .07½
Flour, bag, cwt.	1.60 – 3.00	1.60 – 3.00	1.60 – 3.00
Tin Oxide, bbl., lb.	.55 –	.55 –	.54 –
Crystals, bbl., lb.	.39½–	.39½–	.38½–
Zinc, chloride, gran., bbl., lb.	.05 – .06	.05 – .06	.05 – .06
Carbonate, bbl., lb.	.14 – .15	.14 – .15	.14 – .15
Cyanide, dr., lb.	.33 – .35	.33 – .35	.33 – .35
Dust, bbl., lb.	.09½–	.09½–	.09½–
Zinc oxide, lead free, bag, lb.	.07½–	.07½–	.06½–
5% lead sulphate, bags, lb.	.07½–	.06½–	.06½–
Sulphate, bbl., cwt.	3.40 – 3.50	3.15 – 3.25	3.15 – 3.25

OILS AND FATS

	Current Price	Last Month	Last Year
Castor oil, 3 bbl., lb.	$0.13½–$0.14¼	$0.12½–$0.13	$0.10½–$0.11
Chinawood oil, bbl., lb.	.38 –	.35 –	.28 –
Coconut oil, Ceylon, tank, N. Y., lb.	nom	nom	.04 –
Corn oil crude, tanks (f.o.b. mill), lb.	.12½–	.12½–	.06½–
Cottonseed oil, crude (f.o.b. mill), tanks, lb.	.12½–	.12½–	.06 –
Linseed oil, raw car lots, bbl., lb.	.125–	.117–	.097–
Palm, casks, lb.	.09 –	.09 –	nom
Peanut oil, crude, tanks (mill), lb.	.13 –	.13 –	.06 –
Rapeseed oil, refined, bbl., lb.	nom	nom	.13½–
Soya bean, tank, lb.	.11½–	.11½–	.05½–
Sulphur (olive foots), bbl., lb.	.19 –	.19 –	.11 –
Cod, Newfoundland, bbl., gal.	nom	nom	nom
Menhaden, light pressed, bbl., lb.	.112–	.112–	.09 –
Crude, tanks (f.o.b. factory) gal.	.66 –	.63 –	1.37 –
Grease, yellow, loose, lb.	.09295–	.09295–	.04½–
Oleo stearine, lb.	.09½–	.09½–	.06 –
Oleo oil, No. 1	.11½–	.11½–	.07½–
Red oil, distilled, dp.p. bbl., lb.	.12 –	.12 –	.06½–
Tallow extra, loose, lb.	.097125–	.097125–	.05½–

The accompanying prices refer to round lots in the New York market. Where it is the trade custom to sell f.o.b. works, quotations are given on that basis and are so designated. Prices are corrected to March 12

"Side-kicks" for the CHEMICALS and C-B

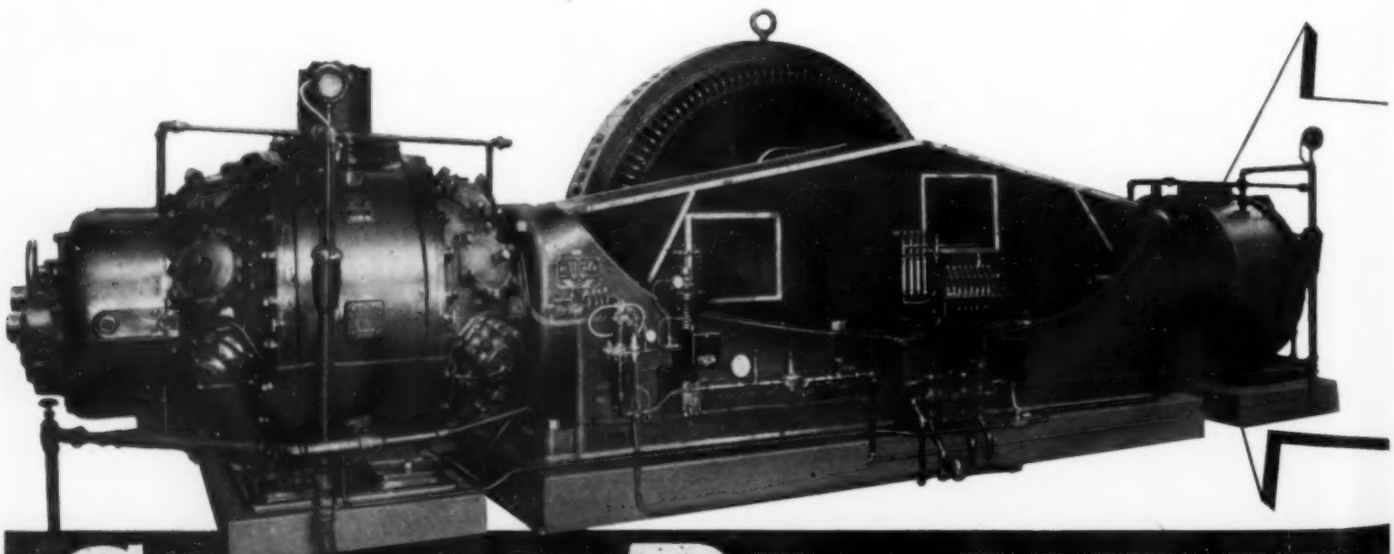
Hundreds of peacetime chemical processes are served by Cooper-Bessemer Compressors. Today the chemical industries are at war . . . and C-B Compressors are with them in the all-out drive to Victory!

These heavy-duty gas-engine, diesel-engine, and motor-driven units are at work in many of the largest chemical plants. They're helping to make high-octane fuels, hydrogen, helium, alcohol, ethylene glycol, synthetic rubber, plastics, acetylene, ammonia for the making of explosives . . . all vital war materials!

Behind the machines stand our engineers . . . ready to work with you. Whether you need special cylinders for unusual gases or pressures, complete compressor units, or automatic controls for the exact regulation of process and product, these men and machines are your side-kicks for the duration! Call upon them.

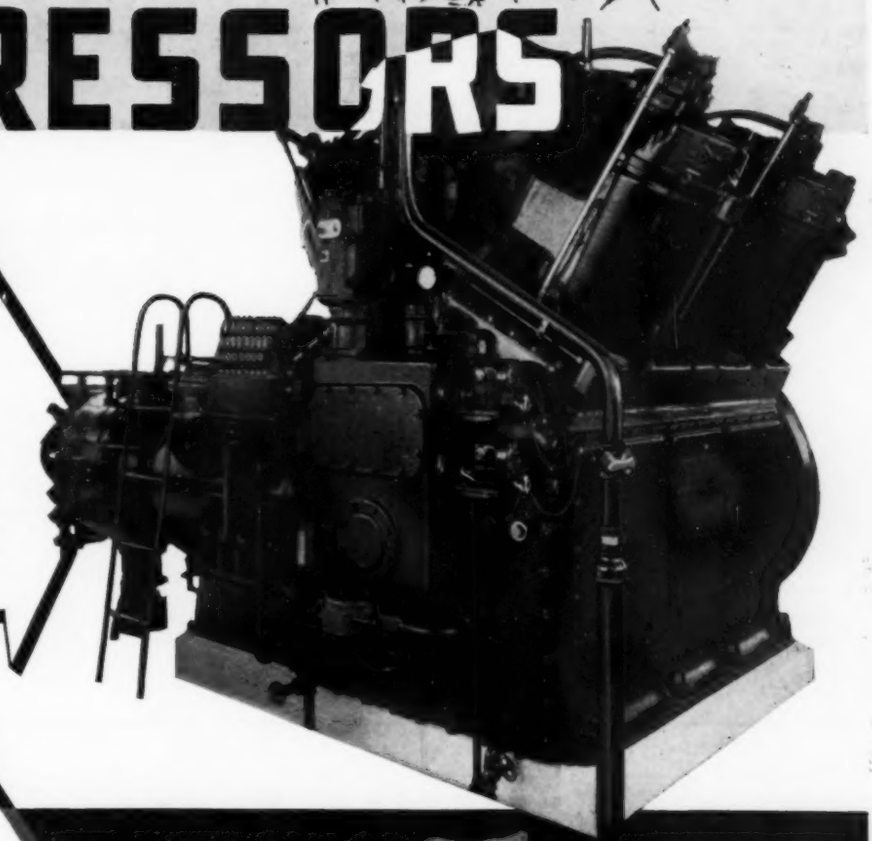
THE COOPER-BESSEMER CORPORATION, Mount Vernon, Ohio

Engine Builders Since 1833



Cooper-Bessemer

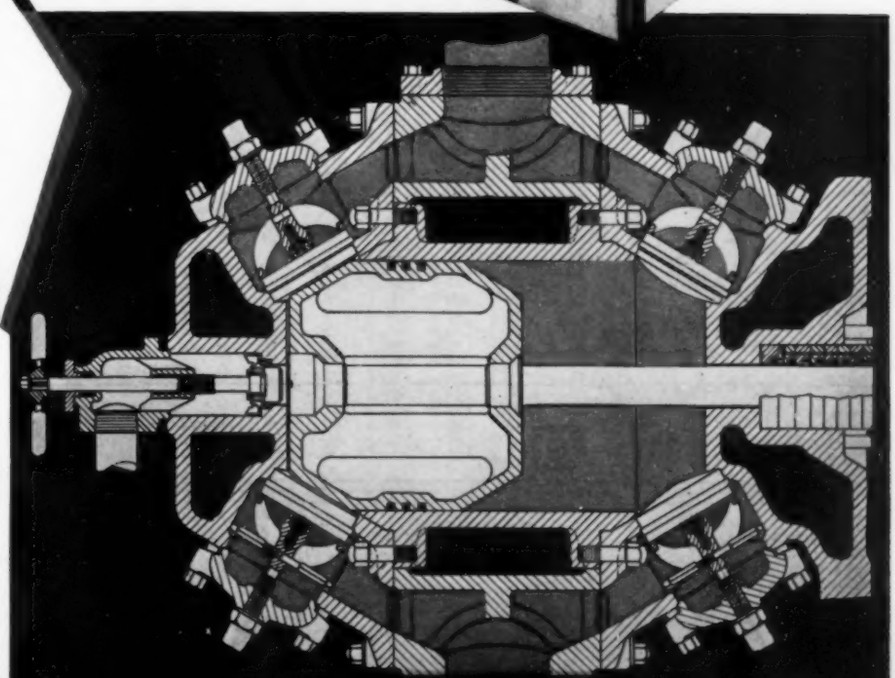
Duration!- COMPRESSORS



For Gas or Diesel Power

Compact and efficient is the GMV compressor. V-angle arrangement of power cylinders gives double horsepower in given floor space over straight-angle and horizontal types. Gas or Diesel units, in 4, 6, 8 and 10-cylinder sizes, rated 400, 600, 800 and 1,000 hp. Each crankthrow will accommodate a separate compressor cylinder, of any desired type. This is industry's most flexible heavy duty compressor.

Compressor cylinders, designed and built by Cooper-Bessemer, develop and maintain up to 6000-pound working pressures. Removable cylinder liners permit use of corrosion-resistant metals for unusual gases. Other distinctive features include a unique valve lifting arrangement, exact control devices, positive lubrication, and quick accessibility of all working parts.



CROSS SECTION OF COMPRESSOR CYLINDER
SHOWING GAS CIRCULATION WATER CIRCULATION

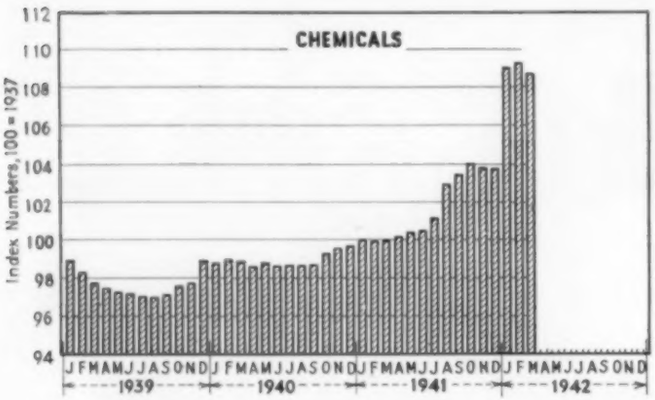
For Electric Power

Dependability of Cooper-Bessemer slow-speed heavy-duty horizontal compressors has been proved by 33 years' experience with gas-engine units. This type is now available in motor-driven units—single and twin cylinder and tandem, 500 to 3000 hp.

Compressors

COOPER BESSEMER EST. 1833

Chem. & Met.'s Weighted Price Indexes


CHEMICALS
Index Numbers, 100 = 1937
112
110
108
106
104
102
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98
96
94
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
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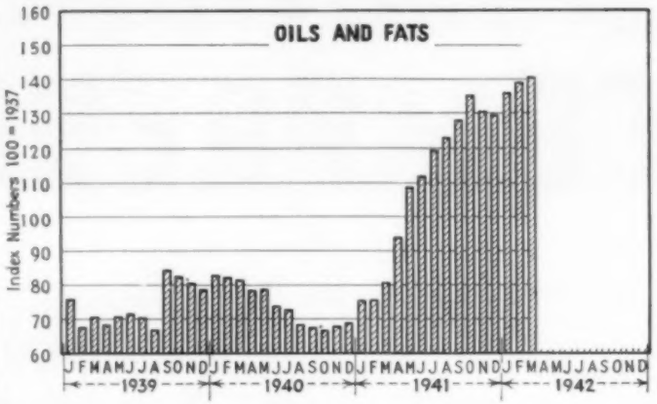

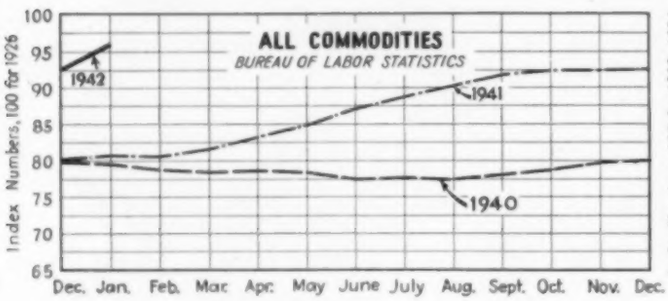

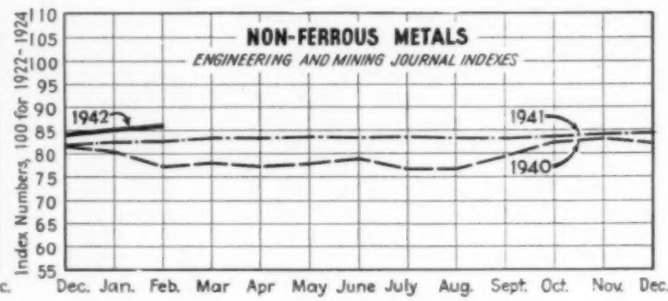

Coal-Tar Products

	Current Price	Last Month	Last Year
Alpha-napthol, crude bbl., lb.	$0.52 -$0.55	$0.52 -$0.55	$0.52 -$0.55
Alpha-naphthylamine, bbl., lb.	.32 - .34	.32 - .34	.32 - .34
Aniline oil, drums, extra, lb.	.15 - .16	.15 - .16	.15 - .16
Aniline, salts, bbl., lb.	.22 - .24	.22 - .24	.22 - .24
Benzaldehyde, U.S.P., dr., lb.	.85 - .95	.85 - .95	.85 - .95
Benzidine base, bbl., lb.	.70 - .75	.70 - .75	.70 - .75
Benzoic acid, U.S.P., kgs., lb.	.54 - .56	.54 - .56	.54 - .56
Benzyl chloride, tech., dr., lb.	.23 - .25	.23 - .25	.23 - .25
Benzol, 90%, tanks, works, gal.	.15 -.....	.15 -.....	.14 -.....
Beta-naphthol, tech., drums, lb.	.23 - .24	.23 - .24	.23 - .24
Cresol, U.S.P., dr., lb.	.11 -.....	.11 - .11	.09½- .10
Cresylic acid, dr., wks., gal.	.81 - .83	.81 - .83	.58 - .60
Diethylaniline, dr., lb.	.40 - .45	.40 - .45	.40 - .45
Dinitrophenol, bbl., lb.	.23 - .25	.23 - .25	.23 - .25
Dinitrotoluol, bbl., lb.	.18 - .19	.18 - .19	.15½- .16
Dip oil, 15%, dr., gal.	.23 - .25	.23 - .25	.23 - .25
Diphenylamine, dr. f.o.b. wks., lb.	.60 -.....	.60 -.....	.....
H-acid, bbl., lb.	.45 - .50	.45 - .55	.45 - .50
Naphthalene, flake, bbl., lb.	.07 - .07½	.07 - .07½	.07 - .07½
Nitrobensene, dr., lb.	.08 - .09	.08 - .09	.08 - .09
Para-nitraniline, bbl., lb.	.47 - .49	.47 - .49	.47 - .49
Phenol, U.S.P., drums, lb.	.13 -.....	.13 -.....	.12 -.....
Picric acid, bbl., lb.	.35 - .40	.35 - .40	.35 - .40
Pyridine, dr., gal.	1.70 - 1.80	1.70 - 1.80	1.70 - 1.80
Resorcinol, tech., kegs, lb.	.75 - .80	.75 - .80	.75 - .80
Salicylic acid, tech., bbl., lb.	.33 - .40	.33 - .40	.33 - .40
Solvent naptha, w.w., tanks, gal.	.27 -.....	.27 -.....	.27 -.....
Tolidine, bbl., lb.	.86 - .88	.86 - .88	.86 - .88
Toluol, drums, works, gal.	.33 -.....	.33 -.....	.30 -.....
Xylol, com, tanks, gal.	.26 -.....	.26 -.....	.26 -.....

Miscellaneous

	Current Price	Last Month	Last Year
Barytes, grd., white, bbl., ton.	$22.00-$25.00	$22.00-$25.00	$22.00-$25.00
Casein, tech, bbl., lb.	.19½- .25	.29½- .30	.11½- .13
China clay, dom., f.o.b. mine, ton.	8.00 -20.00	8.00 -20.00	8.00 -20.00
Dry colors			
Carbon gas, black (wks.), lb.	.0335- .30	.0335- .30	.028- .30
Prussian blue, bbl., lb.	.36 - .37	.36 - .37	.36 - .37
Ultramarine blue, bbl., lb.	.11 - .26	.11 - .26	.10 - .26
Chrome green, bbl., lb.	.21½- .30	.21½- .30	.21 - .27
Carmine, red, tins, lb.	4.60 - 4.75	4.60 - 4.75	4.85 - 5.00
Para toner, lb.	.75 - .80	.75 - .80	.75 - .80
Vermilion, English, bbl., lb.	3.05 - 3.10	3.05 - 3.10	3.12 - 3.20
Chrome yellow, C.P., bbl., lb.	.14½- .15½	.14½- .15½	.14½- .15½
Feldspar, No. 1 (f.o.b.N.C.), ton.	6.50 - 7.50	6.50 - 7.50	6.50 - 7.50
Graphite, Ceylon, lump, bbl., lb.	.08 - .10	.08 - .10	.06 - .06½
Gum copal Congo, bags, lb.	.09 - .30	.09 - .30	.06 - .30
Manila, bags, lb.	.09 - .15	.09 - .14	.09 - .14
Damar, Batavia, cases, lb.	.10 - .22	.10 - .20	.08 - .24
Kauri, cases, lb.	.18 - .60	.18 - .60	.18½- .60
Kieselguhr (f.o.b. mines), ton.	7.00 -40.00	7.00 -40.00	7.00 -40.00
Magnesite, calc, ton.	64.00 -.....	65.00 -.....	65.00 -.....
Pumice stone, lump, bbl., lb.	.05 - .07	.05 - .08	.05 - .07
Imported, casks, lb.	nom	nom	.03 - .04
Rosin, H., 100 lb.	3.83 -.....	3.90 -.....	2.44 -.....
Turpentine, gal.	.80½-.....	.81½-.....	.44½-.....
Shellac, orange, fine, bags, lb.	.43 -.....	.43 -.....	.27 -.....
Bleached, bonedry, bags, lb.	.40 -.....	.40 -.....	.28 -.....
T. N. Bags, lb.	.32 -.....	.32 -.....	.20 -.....
Soapstone (f.o.b. Vt.), bags, ton.	10.00 -12.00	10.00 -12.00	10.00 -12.00
Talc, 200 mesh (f.o.b. Vt.), ton.	8.00 - 8.50	8.00 - 8.50	8.00 - 8.50
200 mesh (f.o.b. Ga.), ton.	6.00 - 8.00	6.00 - 8.00	7.50 -11.00

Industrial Notes

REPUBLIC FILTERS, INC., Paterson, N. J., is now the corporate name of the company which formerly operated as the American Seitz Filter Corp. There has been no change in management or personnel.

THE COWLES DETERGENT CO., Cleveland, is now represented in Northeastern Ohio and Northwestern Pennsylvania by Robert V. Finch who has had many years experience in the organization.

THE DEVILBISS CO., Cleveland, has moved its Missouri sales and service branch to 2737 Washington Ave., St. Louis.

THE H. K. FERGUSON CO., Cleveland, announces that Sidney H. Birdseye has joined the company in the capacity of topographical engineer. Mr. Birdseye was in charge of topographical mapping of the site for the Wolf Creek Ordnance Plant of which the Ferguson company was co-builder.

TESCO CHEMICAL CO., Atlanta, Ga., has been formed by T. E. Schneider who has purchased the detergent products division of the International Minerals & Chemical Corp. Mr. Schneider had been acting as sales manager of the chemical division of the corporation.

POMONA PUMP CO., Pomona, Calif., has purchased the Westvaco Pump division of Micro-Westco, Inc,. Bettendorf, Iowa. The newly acquired business will be operated as the Westco division of the parent company and the management and key personnel of Westco will be transferred to St. Louis where manufacture will be continued.

CHEMICAL SOLVENTS, INC., New York, has moved its executive offices to 60 Park Place, Newark, N. J., where they are near the plant and warehouses.

PHILADELPHIA QUARTZ CO., Philadelphia, has appointed John C. Russel as assistant sales manager where he will work under J. P. Elkinton, vice-president in charge of sales and Edwin A. Russel, sales manager.

MANNING, MAXWELL & MOORE, INC., Bridgeport, Conn., has appointed Albert A. Haniford to their sales department to extend their program of sales training for company salesmen.

PITTSBURGH PLATE GLASS CO., Pittsburgh, has placed M. E. Carlisle in charge of purchase to succeed J. A. Bechtel who has retired after 50 years with the company.

COLGATE - PALMOLIVE - PEET CO., Jersey City, has appointed Thomas Butcher assistant advertising manager.

THE POTASH COMPANY OF AMERICA, New York, is now represented in the midwest by Tobias E. Bradley with headquarters in the Lehmann Bldg., Peoria, Ill.

No. 4 in a series of advertisements about new chemicals.

INVESTIGATE These Versatile New Chemicals

TRICHLORETHANE

$ClCH_2CHCl_2$

. . . is a colorless, volatile, non-flammable liquid soluble in most organic solvents, but difficultly soluble in water (0.48 per cent at 25°C.). It is stable under ordinary conditions of use, and is a good solvent and extractant for most oil, fats, and waxes, as well as natural and certain types of synthetic rubber. Its specific gravity at 20/20°C. is 1.4438; its boiling point at 760 mm. is 113.5°C.

DICHLORISOPROPYL ETHER

$ClCH_2(CH_3)CHOCH(CH_3)CH_2Cl$

. . . is similar to dichlorethyl ether. It is miscible with almost all oils and organic liquids, and is an excellent solvent and extractant for fats, waxes, and greases. It should be useful in paint and varnish removers, spotting agents, and cleaning solutions, and as an intermediate in the manufacture of dyes, resins, and pharmaceuticals. It has value as a soap assistant in high temperature textile operations. Its properties include: boiling point, 187.3°C.; specific gravity at 20/20°C., 1.1122; solubility in water at 20°C., 0.17 per cent.

POLYETHYLENE GLYCOL 200
POLYETHYLENE GLYCOL 300
POLYETHYLENE GLYCOL 400

$HO(CH_2CH_2O)_xH$

. . . are mixtures of higher glycols, having average molecular weights corresponding to the suffixed number. They are viscous, light-colored, hygroscopic liquids, and are soluble in water and many organic substances, but insoluble in aliphatic hydrocarbons. They are solvents for nitrocellulose; plasticizers for casein and gelatin compositions, glues, cork, polyvinyl alcohol, and special printing inks; and raw materials for alkyd resins of unusual properties.

You may discover valuable uses

THE new chemicals described here possess properties which may well result in profitable uses in your plant. Here is a non-flammable solvent . . . a high-boiling chlorinated ether . . . a family of water-soluble plasticizers. The applications given, however, are but suggestions of the wide range of possible uses for these versatile materials.

These interesting new chemicals are timely additions to the group of more than 160 synthetic organic chemicals produced commercially by Carbide and Carbon Chemicals Corporation, and, like the others, are products of the same, continuing research.

Right now only limited quantities can be supplied, but later larger quantities may be available when large-scale applications develop.

For information concerning the use of these chemicals, address:

Carbide and Carbon Chemicals Corporation

Unit of Union Carbide and Carbon Corporation

30 East 42nd Street UCC New York, N. Y.

PRODUCERS OF SYNTHETIC ORGANIC CHEMICALS

CHEM & MET NEW CONSTRUCTION

	Current Projects		Cumulative 1942	
	Proposed Work	Contracts	Proposed Work	Contracts
New England	$2,500,000	$100,000	$2,550,000	$125,000
Middle Atlantic	1,650,000	35,040,000	2,401,000	23,813,000
South	3,165,000	3,130,000	3,305,000	3,000,000
Middle West	20,190,000	340,000	28,280,000	16,435,000
West of Mississippi	6,632,000	250,000	39,972,000	40,050,000
Far West	245,000	25,500,000	4,895,000	69,321,000
Canada	3,560,000	540,000	4,812,000	540,000
	$37,942,000	$64,900,000	$86,215,000	$153,284,000

PROPOSED WORK

Ala., Birmingham—Shell Petroleum Corp., 909 North 28th St., plans to construct an oil storage plant. C. D. Farries, Birmingham, Engr. Estimated cost $125,000.

Ark., Lewisville—Arkansas-Louisiana Gas Co., Little Rock, plans to construct a desulphurization plant to produce sweet gas. Estimated cost $3,500,000.

Calif., San Jose—Zellerbach Paper Co., 534 Battery St., San Francisco, plans to construct a warehouse here. Estimated cost $45,000.

Conn., Canaan—New England Lime Co., Wm. Crowe, Mgr., Bragg St., contemplates the construction of a magnesium plant. Estimated cost $2,500,000.

D. C., Wash.—War Dept. plans to construct a processing plant. Estimated cost $3,000,000.

Ind., Anderson—Philadelphia Quartz Co., 121 South Third St., Philadelphia, Pa., plans to rebuild its chemical plant here. Estimated cost including equipment $50,000.

Ind., Newcastle—Schacht Rubber Div. of Firestone Corp., East Conner St., Noblesville, has purchased a plant here and plans to remodel same. Estimated cost including equipment $100,000.

Md., Baltimore—Koppers Co., Bartlett-Hayward Div., 200 Scott Co., is having plans prepared by J. R. Edmunds, Jr., Archt., Calvert Bldg., and will soon take bids for the construction of a 1 and 2 story factory building. Estimated cost $250,000.

Mich., Midland—Headquarters of Dow Chemical Co. plans to construct a chemical plant. Estimated cost including plant and equipment $20,000,000.

Nebraska—Farm Crops Processing Corp., 510 Barkley Bldg., Lincoln, recently organized, plans to construct five alcohol processing plants at various locations. Estimated cost $3,000,000.

N. Y., Brooklyn—Vulcan Proofing Co., First Ave. and 58th St., is having plans prepared by Wm. Higginson & Son, Archts., 101 Park Ave., New York City, for altering 2 story factory. Estimated cost $250,000.

N. Y., Douglaston—Hazeline Service Corp., 1775 Bway., New York City, is having plans prepared for a 1 story laboratory, factory and office building, at Little Neck Pkway. Estimated cost $70,000.

Pa., Emlenton—Quaker State Oil Refining Co., Sterling Oil Co. Div., D. B. Hunter, Gen. Mgr., is having plans prepared for the construction of a dewaxing plant. Estimated cost $1,000,000.

Pa., Retort—(Powelton P. O.)—Harbison-Walker Refractories Co., Farmers Bldg., Pittsburgh, Pa., plans to rebuild its storage plant. Estimated cost $40,000.

D. C., Washington—War Dept., 20th and Constitution Aves., plans to construct three chemical plants.

Pa., Pittsburgh—Headquarters Koppers Co., Koppers Bldg., contemplates the construction of a chemical plant.

Tex., Houston—E. North, Travis and Webster Sts., plans to construct a chemical plant. Estimated cost $40,000.

Tex., Houston—Walter Ruska & Co., Inc., 2332 Bellaire Blvd., are having plans prepared by Mackie & Kamrath, Archts., 2017 West Gray Sts., for a 1 and 2 story, 50x125 ft. laboratory. Estimated cost $52,000.

Tex., Texas City—Monsanto Chemical Co., 1700 South Second St., St. Louis, Mo., has acquired an 8 story building here and plans to remodel same for its own use.

Wash., Tacoma—Wilkeson Products Co., c/o B. C. Grosscup, Republic Bldg., Seattle, plans to construct a coke plant. Estimated cost $200,000.

Wis., Milwaukee—Milwaukee Gas Specialty Co., 2025 West Clybourn St., plans to construct a plant. Estimated cost $40,000.

B. C., Vancouver—Color-Tone, Ltd., 314 Standard Bank Bldg., plans to construct a chemical plant.

B. C., Victoria—British American Paint Co., Ltd., 200 Belleville St., is having plans prepared by H. Savage, Archt., Scollard Bldg., for an addition to its plant.

Ont., Sarnia—Department of Munitions & Supply, Ottawa, plans to construct a synthetic rubber plant. Estimated cost $3,000,000.

Ont., Toronto—Twentieth Century Chemicals, Ltd., c/o I. E. Houser, 36 Toronto St., plans to construct a plant. Estimated cost $40,000.

Ont., Windsor—Canadian Industries, Ltd., 4016 Sandwich St., is having plans prepared by Evart, Aymer & Byam, Archts., 36 Toronto St., Toronto, for an addition to its caustic soda plant. Estimated cost $100,000.

Que., Montreal—Dominion Government, Ottawa, Ont., plans to construct a synthetic rubber plant. Estimated cost $250,000.

Que., Montreal—Rexlon Chemical Products, Ltd., c/o J. W. Anderson, C. E., St. Lambert, for the construction of a plant. Estimated cost $50,000.

Sask., Palo—Mildweat Chemicals, Ltd., Palo, will soon receive bids for an addition to its plant. Estimated cost $40,000.

CONTRACTS AWARDED

California—Industrial Co., has awarded the contract for chemical plant to Bechtel-McCone-Parsons Corp., 601 West 5th St., Los Angeles. Estimated cost $25,000,000.

D. C., Wash.—Federal Government has awarded the contract for aluminum fabricating plant to United Engineering & Foundry Co., First Natl. Bldg., Pittsburgh, Pa.; clearing and grading site to Kuckenberg Construction Co., 1104 N. E. Holman St., Portland, Ore.; concrete structures and office building to L. H. Hoffman, 715 S. W. Columbia St., Portland, Ore. Estimated cost $35,000,000.

Conn., Fairfield—Bridgeport Molded Products, Inc., Kings Highway, Manufacturer of plastic products, has awarded the contract for an addition to its plant to W. G. Storch Co., 1 Hanson Pl., Brooklyn, N. Y. Estimated cost $60,000.

Ill., Chicago—Dearborn Chemical Co., 1029 West 35th St., has awarded the contract for a 2 story, 82x100 ft. top addition to its plant to Dahl-Stedman Co., 11 South La Salle St. Estimated cost $50,000.

Ky., Louisville—Park & Tilford Distilleries, 35th and Tyler Sts., has awarded the contract for an 8 story warehouse to Hays & Nicoulin, 939 Franklin St., Louisville. Estimated cost $130,000.

Mass., Cambridge—Dewey & Almy Chemical Co., 62 Whittemore Ave., has awarded the contract for a 2 story addition to its factory to L. C. Blake Construction Co., 50 Dyer Ave., Milton, Mass. Estimated cost $40,000.

O., Cleveland—Aluminum Co. of America, 2210 Harvard Ave., has awarded the contract for 3 story, 31x95 ft. and 19x31 ft. factory additions to Leo. W. Schmidt, Inc., Granger Rd. Estimated cost $100,000.

O., Cleveland—American Metal Treating Co., 1043 East 62nd St., has awarded the contract for a 2 story, 36x80 ft. addition to its factory to J. L. Hunting Co., 9th and Chester Bldg. Estimated cost $40,000.

Okla., Cromwell—Shell Oil Co., Inc., Mayo Bldg., Tulsa, has awarded the contract for a gasoline plant to Frick-Reid Supply Co., East Third St., Tulsa. Estimated cost $250,000.

Ore., Port Orford—Krome Corp., W. G. Heller, Mgr., Port Orford, has awarded the contract for a chrome concentrating plant to Southwestern Engineering Co., 4800 Santa Fe Ave., Vernon. Estimated cost $500,000.

Pa., New Castle—Johnson Bronze Co., P. J. Flaherty, Pres., 500 South Hill St., will construct a 1 story, 100x150 ft. factory, with own forces.

West Virginia—Corning Glass Works, Corning, N. Y., has awarded the contract for the construction of plant to H. K. Ferguson Co., 1650 Hanna Bldg., Cleveland, O. Estimated cost $2,000,000.

West Virginia—Pittsburgh Plate Glass Co., Grant Bldg., Pittsburgh, Pa., has awarded the contract for four factory buildings to H. K. Ferguson Co., 1650 Hanna Bldg., Cleveland, O.

Wis., Browntown—Browntown Silica Co., c/o P. W. Palmer, Edgerton, has awarded the contract for rebuilding its plant to George Nelson & Son, 1117 West Johnson St., Madison. Estimated cost $150,000.

Man., Winnipeg—Dominion Government, Ottawa, Ont., Can., has awarded the contract for chemical manufacturing plant to Defense Industries, Ltd., Ottawa, Ont. Estimated cost $500,000.

Que., Asbestos—Canadian Johns-Manville Co., Ltd., Sun Life Bldg., Montreal, Que., has awarded the contract for an addition to its plant to McKinnon Steel Corp., Ltd., 14 Industrial St., Sherbrooke. Estimated cost $40,000.